THE PRINCIPLES OF APPRENTICE TRAINING

BY

A. P. M. FLEMING

AND

J. G. PEARCE

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WITH SPECIAL REFERENCE TO THE
ENGINEERING INDUSTRY

BY

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The services employed in industry comprise a number of grades, which may be divided into two broad classes, consisting of manual and non-manual workers. Important as is the latter, it is the former which at the present time demands the greater attention.

Different industries in a community present certain distinguishing features, and although there is considerable local variation in manufacturing conditions, similar fundamental considerations apply to all industries in all countries. These involve the selection of workers for particular positions according to inherent suitability, and their education and training along lines tending to produce greatest economy of working.

It is the purpose of this book to inquire into these considerations in so far as they affect the skilled manual worker. Attention is paid principally to conditions in England and to workers engaged in engineering manufacture, but the general treatment and conclusions apply universally.

Of the four parts into which the book is divided, the first deals with the place of the manual worker in industry and the economic importance of training to the individual, to the community, and to the State.

In the second part the characteristics demanded from a worker by virtue of a manual occupation are set forth, and the extent to which these are developed by the existing educational system is discussed. Suggestions are made as to the lines on which education may be readjusted to suit modern industrial needs without in any way making it conform to a purely utilitarian ideal.

The third part emphasises the need for a means of careful selection of youths according to their vocational fitness, and points to the extremely haphazard conditions under which boys at present enter industrial work. The guidance afforded by parents, guardians, educational authorities, and the means of selection adopted by employers is considered, and a scheme outlined whereby vocational selection may be effected according to a definite and systematic plan until a more scientific method is forthcoming.

The fourth part is devoted to the consideration of artisan training. Existing methods in various industrial countries are described, and the underlying requirements of training stated, followed by the development of a plan suited to modern conditions. Finally, an example is given of a system of training developed by the authors in a large manufacturing organization in which the principles laid down are embodied.

In outlining requirements for selection and training of industrial workers, the authors are appreciative of the place which such vocational preparation should take in a wider scheme of education—in the specific preparation for citizenship. Important as the latter undoubtedly is, the institution of sound principles of vocational selection, which will enable a worker to earn a living in the occupation for which he is best fitted, is the first step towards making him a satisfied individual. Suitable training then lays a foundation for those characteristics likely to render him useful to the community, and thus provides a basis for good citizenship, the development of which would be the inevitable outcome of the general introduction of such training.

To the solution of the problem of a voluntary or compulsory basis of attendance at continuation schools, only an indirect contribution is offered. While the scheme of training here outlined is compulsory for all apprentices, boys are under no obligation—many, indeed, are not permitted—to accept apprenticeship. Those who enter an apprentice course do so because they are desirous of becoming skilled workers, and of possessing the advantages which skilled workers can command. Training is, however, none the less necessary to other workers, and the average youth may be made to do much, without compulsion, if his latent ambition is fired and rightly guided.

Whether future legislative enactment compels attendance or not, any scheme of continuation education can only succeed with the co-operation of employers and their skilled assistants; not merely in the passive sense of encouraging evening school attendance and benevolently rewarding it, or even in making it a condition of employment, but in the active use of their experience and knowledge, which educational experts do not and cannot possess, in the framing of courses and the formulation of curricula which shall render the schools of real value to the industrial rank and file.

It is inevitable that a book of this description should bear unmistakable signs of its origin, of the workshop rather than of the study, but it is hoped that this fact may render it even more acceptable than a purely academic treatise.

The authors desire to express their grateful thanks to the various educational authorities who have kindly placed records and data at their disposal, and to acknowledge the assistance afforded by the work of various authors to whom reference is made in the text.

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CHAPTER I.

CLASSIFICATION OF INDUSTRIAL WORKERS.

THE development of an industry takes place in several more or less clearly defined stages. Carried on originally in primitive fashion in the homes of the workers themselves, industrial processes readily tend towards a local concentration as soon as labour-saving devices are introduced at some place specially favoured by the presence of raw materials, power, and transport facilities. This concentration of a process or series of related processes necessitates the existence of an organization by means of which the whole may be made to work smoothly. Finally, the industry develops to the stage when, from the working out of theory and practice, a science is evolved, the application of which supersedes the older empirical methods, and demands the employment of scientifically educated leaders and suitably trained workmen to co-operate in productive effort. In the past it has been possible, in fact quite usual, for men possessing sound common sense and business capacity, although devoid of scientific training, to rise to positions of great importance in controlling this organization. To-day the engineering industry has reached a stage of transition between the penultimate and final stages. Scientific theory is well established and has been extensively applied to practice. The need for fully trained leaders is being generally felt, although there is a great uncertainty regarding the training required for workmen.

Manual and Non-Manual Workers.—All workers in industry may be classed broadly either as manual workers or as non-manual workers ; the former includes all workmen, the latter comprises staff officers and supervisors generally, who form the group of technically employed men, technical training being essential to the effective discharge of their duties.

Non-Manual Workers. — The field of technical employment in an engineering works is covered by the following groups :—

(*a*) Designers, leading draughtsmen, and testers.

(*b*) Technically trained salesmen.

(*c*) Works organizers, including works managers, shop supervisors, and industrial research engineers.

Adequate educational facilities exist to meet the needs of the first two, but, as yet, insufficient attention has been paid to the provision of suitable means for training staff officers of the third group. The organization of engineering works in the past has been largely in the hands of men of broad practical experience but of little or no scientific training. The increasingly exacting requirements of modern works organization demand such training if effective results are to be obtained.

Industrial progress in the past has been largely due to the efforts of isolated workers and inventors—often pursuing their investigations under disadvantageous conditions — and the improvements resulting from their efforts have ultimately become the common property of the industry. Since the progress of an industry depends upon a continual influx of such new knowledge and the application of new discoveries, this requirement becomes increasingly difficult to fulfil by the haphazard means heretofore adopted. Discerning manufacturers are beginning to appreciate the latent industrial possibilities of every scientific discovery and of the fields of science yet unexplored, and are endeavouring to undertake definite and systematic researches with the aid of specially trained investigators. This work has become known as "industrial research," and the investigations which it comprises may be grouped under three heads, namely, those applied to the elimination of manufacturing troubles, with consequent increase in reliability of the product and improved manufacturing efficiency; those directed to the improvement of materials, tools, and methods, which have a direct bearing on cheap production; and investigations in pure science, which are conducted with confidence that their results will sooner or later be applied to industrial processes.

It is to this phase of industrial development that manufacturers have to look for one of their most powerful weapons in the competition for international markets, and it is significant that vast strides have already been made in this direction by German and American manufacturers.

Manual Workers.—Manual workers may also be separated into three main divisions:—

(*a*) The skilled workman or craftsman, such as a moulder, pattern-maker, fitter, turner, armature winder, etc.

(*b*) The "specialist" or repetition worker, utilizing automatic and semi-automatic machinery.

(*c*) The labourer.

Despite the revolutionary changes wrought in the industrial world by the introduction of machinery, there are still a large number of processes performed solely by manual labour. Since such processes require a greater degree of intelligence and skill than others, workers who are trained to follow them will continue to feel entitled either to higher remuneration or to other reward than that obtained in less exacting occupations, although the present disparity in wage rates between the so-called "skilled" and "unskilled" occupations is likely to become less marked as time goes on.

The Labourer.—The lowest grade of manual workers, the labouring class, includes, in general, the least intelligent of the industrial community. But this is by no means the case with all. Some of these have been "blind-alley" workers, others have moral failings, while a considerable number prefer the complete lack of responsibility which their grade of occupation affords. Further, it is extremely unfortunate that the inadequate means of selecting and directing juvenile workers to industry is responsible for the large number who find their ultimate level in the labouring class, but who may be fitted for better work, since every intelligent man whose lack of training compels him to follow that work is a probable centre of dissatisfaction, and a grave economic loss to the community.

The Specialist.—The class of labour referred to as "specialist" may include men or women; in the case of the former, it is generally recruited from among those workers who have for some years after leaving school followed a form of employment offering no prospects, and who, at or about adult age, grasp the opportunity of obtaining work at a rate of wage required by an adult, not too far short of that of the craftsman, without having to undergo the training needed by the latter. In other cases, boys take up this work early after leaving school because of the relatively high wages obtained, being prepared to discount their prospects for the sake of the highest immediate return.

As a result of the existing shortage of male labour, the extension of automatic and semi-automatic production, and the splitting up of machining operations, enabling products to be handled in bulk in a series of sequent operations, the employment of women in engineering industries will be brought about on an extended scale. Those dexterous in one operation only will find a place, and with the movement will be introduced new industrial problems,[1] which are already giving grave concern to employers and labour leaders.

In many respects, women workers perform repetition operations with much less mental fatigue than men, and often prefer this work to that of a less monotonous but more responsible character. Moreover, recent experience in the employment of women for the manufacture of munitions indicates that women workers rapidly acquire manual dexterity of a limited order. In some cases men are able to carry out similar work involving a series of actions on an automatic machine without diminution in productive capacity over long periods of working. These facts suggest that there are some workers who are inherently fitted for this class of work from a mental and physical point of view, and hence selection should be carefully made with due regard to these factors.

The Craftsman.—The work of a skilled craftsman demands much wider experience, skill, and intelligence than either of the previous groups. It is customary for a boy who, after leaving school, wishes to become such a workman, to enter a works for an apprenticeship, which ends, in England, on the attainment of his majority, in the United States and Germany, usually about the age of eighteen. Generally he comes of artisan parents, and is above the average in respect of elementary education. For various reasons, however, formal engineering apprenticeship sealed by legal indentures has fallen into

[1] See Section F, British Association, Manchester, 1915. Interim Report on Industrial Fatigue.

disuse, and is not likely to be revived. Frequently a simple verbal or written agreement is substituted, the employer retaining the right to discharge a boy who does not work satisfactorily, the youth tacitly retaining the right to leave if he should become dissatisfied with the working conditions. There is, however, no doubt that the decline of formal apprenticeship has been mainly responsible for the failure adequately to train sufficient skilled workers to supply the needs of industry, and this is rapidly producing a state of affairs which is inimical to the interests of any country the prosperity of which depends on its commerce. There is an urgent need for the introduction of a definite system of training for engineering workers, particularly of the skilled class. Apart from his value to himself and to the community as a workman, a skilled man is less likely to be out of employment than any other class of worker; his long training gives him a sturdier character and consequently makes him a better member of the community.

Distinction between Trade and Technical Employment.— It is characteristic of our lack of appreciation of the changes taking place in the industrial world, that misunderstanding and confusion should still exist regarding the nature and scope of non-manual or technical employment, and the way in which it differs from manual or trade employment. Although there is a wide difference in function between those employed in the two grades, it is still popularly supposed that the training found necessary for the one is suitable for the other. Clear recognition should be given to the fact that in the higher branches of work engineering is a profession demanding a training at least as long as, or longer than, and quite as costly as that required for any other profession, such as law or medicine. It is desirable for any man who wishes to become a professional engineer to follow a sound secondary education with a university course in a faculty of applied science for a period of three or four years. Subsequently a practical course in an actual works, occupying a further two or three years, is essential; then professional work may be commenced. No man who omits the practical training has any likelihood of succeeding as an engineer, and in order to afford as wide a range of experience in commercial practice as possible, a special course for this should be arranged. On the other hand, the would-be craftsman invariably enters a works after leaving the primary[1] school, and acquires manipulative skill during a long apprenticeship of six or seven years. While he should know something of the tools and materials with which he works, his knowledge will naturally not have the depth and the mathematical basis of that of a technically educated man, and in some respects it will be different. The fact that it was once possible, when engineering science did not exist, for workers not trained scientifically to become leaders in the industry is responsible for the popular confusion between the engineer and craftsman. It is of the utmost importance that all workers with sufficient ability should be able to pass from one grade to the other, but as time goes on it will become increasingly difficult to do so, owing to the increasing complexity of scientific training, which will necessitate special preparation before actual entry into industrial work. The necessary upward mobility can best be secured by offering facilities for adequate preliminary training to suitable youths. A highly skilled craftsman is in many respects in a much better position than an unsatisfactory and inferior technical worker.

A broad definition of the difference between the two

[1] The word "primary" is used throughout in preference to "elementary".

classes in terms of the knowledge they have to acquire will be assisted by the realization of the function the workers in each class have to fulfil, and, for completeness, the function assigned to the repetition worker may be included.

Any thought or object on which the attention is concentrated may be diagrammatically considered to be at the centre or focus of an area representing the field of consciousness. When the attention is held by an object, there is associated with the consciousness of it a vague realization of the presence or existence of other objects which may be said to be within the field of consciousness but away from the focus. The margin of consciousness occupied by these things is represented by that part of the area enclosed by the boundary line which is away from the focus. Any action which is performed automatically may be said to be outside the field of consciousness, i.e. outside the area representing the field. Some of these actions are instinctive, but others have been rendered habitual by constant performance over a long period, and their advantage lies in the fact that many such actions can be performed while the mind is occupied with weightier matters. The work of the specialist who is engaged solely on repetition work rapidly becomes, through long practice, quite habitual. At first the work and the machine are at the focus of consciousness, but after a time familiarity with the method enables the operative to proceed independently of whether his mind is concentrated solely on the work or not. Since the machine occupies a considerable part of the visual field, it is probable that it is generally inside the margin. The worker is seldom or never called upon to meet a new situation, and his work never involves problems which cannot be solved from the limited range of his past experience. He has to make scarcely any new judgments; if this be necessary, he has invariably to ask for skilled assistance.

The skilled workman is in a rather different position. Some part of his work will undoubtedly be carried on automatically, for although it is generally of a far more complex nature than that of the repetition worker, a longer period of training has given him a frequently astonishing rapidity and dexterity, till the work becomes "second nature". It is necessary, however, for the work to be at times at the very focus of consciousness, particularly when it involves thought as to subsequent methods of procedure. The skilled worker of the past, however, has been restricted too much to the line of his previous experience. He meets many situations in the course of the day's work which may be unusual, but practically all of them will have occurred before, and the procedure in all cases is settled with reference to his previous experience. Unless he has an original mind, the average workman seldom strikes any really new thought or idea, and when any thinking has to be done, he finds it necessary to get advice from a technically educated man. The great function of the skilled workman is to form practical judgments on matters which arise in the course of his work, to meet which he has at his disposal a fund of painfully acquired practical experience. Some features of each new situation recall those of a previous one, which bring with them an idea of the way in which it was met, which in turn acts as a basis for the new method, generally similar to the old one. It is significant to note that one such previous experience is sufficient to enable a practical judgment to be formed, while to meet a new situation on a basis of habit necessitates very many previous experiences. Although habit enables the conditions to be met more certainly and rapidly, the scope of the conditions which can be so treated is very narrow. The limitations of practical judgment lie in the danger due to superficial resemblance between a new group of conditions and an old one if there is no underlying principle known to the worker to guide him. Further, only most recent experiences are available for ready recall, which explains why a man cannot leave a skilled trade, even for a short time, without detriment, and also one reason why a teacher of a trade should be allowed to keep in touch with it. In future, it will be desirable to train workmen in the underlying principles of their crafts, so that they are able to solve many problems that arise for themselves, thus eliminating to some extent the need for technical supervision. This process of making the work rational will give the work interest, and will make the workmen more independent of their trade traditions.

The technical worker or engineer is invariably in the position of having to concentrate his work entirely in the focus of consciousness, since he has generally to think carefully about it. He has constantly to face new situations, and to bring his knowledge of fundamental scientific principles and his experience to bear in making what is a new conceptual judgment. Experiences, whether they be personal or racial, are utilized in meeting the new situation in such a way that the significant and salient features of all of them which relate to the situation are abstracted and brought to a new focus in such a way that a new thought is the result. In this way new progress in science is made.[1]

Stated briefly, every man acquires experience, whether through the school or through actual life. That of the specialist worker operates normally as a habit without any conscious effort, and thought would retard his rate

[1] For an analysis of the functioning of experience, see Prof. Bagley's valuable "Educative Process".

of working at once. That of the craftsman is utilized in the formation of practical judgments, which involve the application of concrete experiences, these being gained mainly in a preparatory period of apprenticeship.

In the training of the technical man experiences are organized, causes and effects are related to the definite consistencies of procedure called laws, and superficial resemblances give way to a deep abiding essence or principle, around which experiences are clustered. The prime function of a technical man is that of a thinker.

These considerations make it clear that the function of each class of worker is fundamentally different, and that the training for each must be arranged accordingly. It must not be supposed that one branch of work is necessarily superior to another. The greatest possible economy would be secured if any individual could be placed in that class which would afford best scope for his own special proclivities.

With regard to the technical worker, the requirements as to scientific education and training are now generally well known. Much confusion exists, however, as to the character of instruction needed by the manual worker. This phase of industrial education will subsequently be dealt with fully.

CHAPTER II.

ECONOMIC ASPECT OF THE PROBLEM.

THERE can be no doubt that much of the money expended on education is wasted, owing to the lack of that provision for supplementary training which renders education effective to the mass of workers. The difference in productive value, and consequently of value to the community, of a boy who learns a skilled trade on leaving school compared with one who enters a "blind-alley" occupation, probably becoming a labourer on reaching adult age, offsets to an enormous extent the cost of training of the potential craftsman.[1]

[1] A labourer earning 23s. weekly at the age of twenty-five, with a life expectation of thirty-six years, earns roughly £2150. A skilled workman earning 40s. weekly, under similar conditions, would earn about £3750, an increase of £1600, about 75 per cent on the labourer's total. The possibility of obtaining more by overtime, piecework, etc., and of less loss through unemployment, make, in the aggregate, a large addition to the craftsman's wages. During a seven-year period of training, an engineering apprentice earns about £190, exclusive of overtime, etc. A "blind-alley" worker or labourer, in the same period, under most favourable conditions with respect to wages, earns about £250, leaving a difference of £60. The cost of primary education is identical in each case. Thus a training costing the youth £60 results in a net gain of £1600.

In America industrial conditions are far less uniform, so that a comparison is more difficult. The following figures claim to be based on a study of the cases of 2000 actual workers, although the trained workers will probably include others besides skilled workmen. The net earnings of

The Worker.—Labour, properly selected and trained, represents one of the most important economic features in industry. From the worker's point of view, the possession of certain experience of craft and physical energy represents capital, and the extent to which the individual can develop and employ these assets to the utmost of his capacity, determines the inherent possibilities of return to himself in money and in satisfaction.

As to craft experience, the importance of the most thorough training and its effect on production, both as regards quality and quantity, is self-evident. The proper use of physical effort so that consistency of application can be maintained and the maximum return obtained for the energy expended, depends partly on proper planning of and guidance in the sequence of operations to be carried out, but more especially on the mental attitude adopted by the worker towards the work. It is in this latter connection that an enormous benefit is to be obtained by suitable training. If the work is approached as a potential problem to be solved rather than as an arduous task that must be performed, the co-ordination of mental and physical effort will result in the greatest possible accomplishment for the energy expended. Training, therefore, which makes the worker interested in his employment, which instils in

the trained man are ultimately more than double those of the untrained worker :—

Age.	*Untrained.*		*Trained.*	
14	$4	per week	—	
18	7	,,	$10	per week.
20	9·50	,,	15	,,
22	11·50	,,	20	,,
25	12·75	,,	31	,,

In a similar way, by the introduction of scientific methods of education and training, the value of the artisan of the future may be increased beyond that of the workman trained on present-day lines, for insignificant training costs.

him a sense of pride of achievement, which embodies the importance of avoiding waste of materials, of time, and of effort by a careful study of the most efficient means of accomplishing the operations involved, is of the greatest importance to the worker in enabling him to realize to the full his capacity for production, which is a measure of the possible return.

This conception should not be confused with the scheme which aims at improving output by a close study of the individual motions of a worker, and at eliminating any expenditure of energy not directly involved in and necessary to production, thus tending to a machine-like precision of movement.

The aim here presented is rather a plea for a wider basis of knowledge and interest on the part of the worker, resulting from his acquaintance with the general series of operations of which his work is a part, thereby removing the conception that manual work is a necessary evil. Modern industrial workers are often extremely ignorant of the purpose of their work, and interest cannot be aroused and maintained unless this deficiency is made good. When, in addition, the worker is afforded a knowledge of the very best way of accomplishing results, of the reasons for performing each process, when he is given a knowledge of the materials he uses, is taught how to read drawings, then all his capacity, mental and physical, may be enlisted to the accomplishment of his work; at the same time he is developing into a better all-round man. By means of such development, intelligence and originality may conceivably be increased.

The Employer.—The factors involving expenditure which enter into economic production are labour, material, and general expenses, the latter including such items as rent, rates, taxes, depreciation of machinery, and other charges, many of which are of constant amount, independent of the quantity of work produced. It has been shown already that labour is directly affected by the efficiency of training.[1] To a lesser extent, material costs may be influenced also, since the greater the accuracy of workmanship, the more scientifically accurate and closely calculated may designs be carried out and machining allowances be made. In addition to this economy, there is a direct saving of scrap to be effected by employees in avoiding the tendency, common in engineering and other works, to waste materials through sheer ignorance of their value.

As regards general expenses, these may also be influenced by the training of labour, since apart from variations due to waste of time and materials which enter into such expenses, and which will thus be affected, the greater the production, the smaller will be the amount of general expenses per unit produced. For example, if it were possible to replace the labour in a factory by the same number of specially trained workers who could produce twice the amount done by their predecessors even if these were paid the same amount per unit—and therefore earning twice as much—the manufacturing cost per unit would be reduced, since each unit would involve a smaller portion of factory rent and other general expenses. Further important economies may be effected in connection with the use of expensive tools subject to heavy depreciation, when these are handled by skilled, as compared with relatively poorly trained labour. Taken collectively, the more thorough the training of the worker towards making him a self-directive unit, the smaller the need for supervision and the greater the flexibility of the organization, both directly and indirectly, since it is advantageous for a supervisor to be able to divert labour from one channel to another, according to fluctuations

[1] For a further saving which may be made in this direction, see Chap. VIII.

in business, and to meet urgent needs of production. In general, therefore, the employer who is far-seeing enough to train workers efficiently will secure an important advantage in competition with his less progressive rivals.

The Community.—From the point of view of the community, the more effective the selection and training of the worker, the greater the facility for economic production, which in turn renders the products of industry more easily accessible to the public through a lowering in price. This again stimulates greater production through greater demand, and raises the standard of comfort of the artisan. Thus even those individuals not directly concerned with the advantages of artisan training will reap an indirect benefit, a fact which makes even the material advantages a matter of national concern.

The National Point of View.—The failure to develop each worker by suitable education and training in his properly selected vocation to the utmost of his capacity represents a criminal waste of assets of incalculable value. In many industries the materials of construction in different countries cost much the same, and it is in the matter of labour and organization that one country can produce more economically than another, so that from the point of view of international competition the value of sound training and resultant economic production is obvious. While the necessity for well-trained workers is paramount, the need also for employers and supervisors having the proper appreciation of the value of scientific preparation of workers must be kept clearly in view. In this connection, the higher the degree of training of workmen, the greater the need for raising the standard of the employer. With the wider development of industrial training, the greater will be the possibility of discovering those workers possessing inherent ability to rise to commanding positions, and who are at present too often left in obscurity.

Such men, shaped by higher training, will be best adapted to supervise the training of the rising generation of workers. By guiding a boy into the trade which naturally arouses his greatest interest, and using the trade as a centre for instruction, it will be possible to produce a first-class workman in place of what would otherwise be a poor one. The greater the degree of skill, the greater will be self-respect and self-reliance, all of which make a good workman a favourable nucleus for further instruction in the rights and obligations of citizenship, the fulfilment of which demands, to a very large degree, the exercise of those virtues—self-reliance, accuracy, consistency—which are found in the skilled workman. It has long been appreciated that the skilled workmen are the aristocracy of their class. It is possible by proper training, provided it is suited to the needs of the men and relevant to their special occupation, to raise all workers to a similar status, which would bring with it a desire for increased knowledge, a wider outlook and greater toleration, thus rendering them in every sense more valuable assets to the community.

The need for some system of selection and training merely in order to combat the tendency towards "blind-alley" employment is strikingly shown by the following figures for greater London, given by Mr. N. B. Dearle.[1]

"*Blind-Alley*" *Employments.*—Ages 14-15.—

Junior Clerks and Office Boys	2,457
Van Guards and Junior Carmen	1,923
Messengers and Porters	13,175
	17,555

Skilled Employment.—Numbers in ten selected trades in the same area.

[1] "Industrial Training," by N. B. Dearle.

Fitters and Turners	50
Blacksmiths	42
Electrical Apparatus Makers	378
Precious Metal and Instrument Trades	528
Carpenters and Joiners	110
Plumbers	109
Cabinet Makers	215
Upholsterers	61
Printers and Lithographers	1130
Bookbinders	93
	2716

The way in which the "blind-alley" work is left in the course of one or two years is shown in the table below. From fourteen to fifteen, nearly one-half of the total number of boys available are working in the chief "blind-alley" situations. At nineteen to twenty the proportion is 7·5 per cent. Coincident with the heavy decline is a steady rise in the numbers employed in clerical labour and in the skilled trades, as the figures indicate:—

Age.	14-15.	Per cent.	15-16.	Per cent.	16-17.	Per cent.	19-20.	Per cent.
Total occupied	33,174		49,246		53,675		56,026	
Chief "blind-alley" jobs	15,098	45·5	15,608	31·7	11,169	20·8	4,190	7·5
Clerical labour	2,457	7·4	5,879	11·9	8,140	15·2	8,989	16·0
Selected skilled trades (10)	2,716	8·2	4,848	9·8	5,753	10·7	6,097	10·9
		61·1		53·4		46·7		34·4

An investigation to determine where the "blind-alley" workers go to after their twentieth year would be instructive. Do they fail to enter the skilled trades because the trades cannot find work for them, because they are too old to learn afresh, or because their working conditions have been too demoralizing to allow them to settle to steady work?

PART II.

PRIMARY EDUCATION.

CHAPTER III.

CHARACTERISTICS REQUIRED BY ARTISAN WORKERS.

DESTRUCTIVE criticism of the educational system by business men is one of the most painful commonplaces of our time, but it is seldom possible to elicit from the critics anything further than the general statement that boys leave the primary schools without any real fitness for the life which lies before them. There is no doubt that this impression is derived from wide experience in connection with the employment of boys from school in works and offices, and any display of stupidity and lack of general common sense in minor duties is bound to produce adverse criticism. The most convenient scapegoat is the primary school.

Need for Co-operation between Educationists and Employers.—It frequently happens, however, that such a view is the result of a failure fully to appreciate the difficulties which lie in the path of the educationist, such as the home environment of the child, and the omission of suggestions which might improve matters. Lack of time to devote to consideration of educational problems, and a feeling that the work of educational science has become specialized beyond the average understanding are prime causes of this neglect. Those engaged in manufacturing and industrial processes feel that the teaching of the schools is academic and unpractical, that the scholars are crammed rather than educated. The educationist feels that business men are desirous not of obtaining boys who are educated in the best sense of the term, but rather those who are educated in the narrowest utilitarian sense. He condemns them as unsympathetic with educational ideals or as ignorant of that which they criticize. The best evidence of this attitude is the manner in which some industrial experts put forward unheeded suggestions for reform, while educationists discuss further schemes which are certain to be abortive until their experience has been reinforced by that of the manufacturing community. Although the lack of co-operation is complete, there are welcome signs of improvement. The industrial world is closely following educational developments, and some of its ideas are being put into practice. That the educational world is not free from serious questionings with regard to its present policy is strikingly exemplified by Mr. Welpton, Lecturer in Education at Leeds University.[1]

> Our primary schools train clerks, teachers, and casual labourers. . . . The schoolmaster himself, in every thought and deed, advocates the clerkly ideal of schooling. . . . His good scholars are those good at their books. . . . If our primary schools trained their pupils for a manhood of industry, of hardy physique, and manly spirit, who would be the best pupils then? Surely it would be those best at the joiner's bench and the ironworker's forge, those most eager for games and contests, those with most capable hands, ready wits, and hardy pluck. The budding clerk and teacher would be out of their element there. They would, in practical tasks, gravitate to the bottom of the class. . . . The schoolmaster's learning is a learning of books. He knows no other. He can teach no other. To the life and spirit of practical industry he is an alien. He knows little, and recks nothing, of those qualities of head and hand that go to make the manhood of industry: consequently they have no place in his educational schemes. . . .
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> Let us then sweep our artisan schools clean of the bookish, wordy spirit of the pedagogue and of the passivity, monotony, and uniformity of a desk routine. Let us bring in the active spirit of

[1] See "Primary Artisan Education," W. P. Welpton.

the artisan and craftsman, the noise and bustle of action, the pride in honest manual labour, the joy in a thing well made, the individual movement and thought of independent work, the spirit of manly strife with material to turn it to use, and of human struggle in hardy contests and games. So will the school life become a reflex of real life to which in some measure the school occupations will lead, and for which they will in part prepare. The school, then, will be the real world in miniature, and, as the real world has industries and battles, so, too, will the school have its practical activities and contests.

It is important, then, that education authorities and teachers should give themselves seriously to the task of considering what qualities of mind and body are vitally necessary to the artisan in his capacity as workman, citizen, and man, and of organizing a system of school pursuits that will arouse, foster, and temper these qualities in the young. Speaking broadly, we may class the qualities required by the artisan for his life, as Health and Strength, Practical Intelligence and Skill, and Manly and Hardy Character. . . .

Heredity and Environment.—We may consider that the human infant is born with several innate instincts and a capacity for acquiring an indefinite number of mental characteristics. Broadly speaking, the instincts are there because they have been transmitted, while the mental characteristics, which are latent, will develop provided the immediate surroundings favour their development. As part of these surroundings, we may consider formal education, which is a conscious attempt to develop certain qualities by the provision of a definite mental and physical environment. The remaining part is made up of the normal environment of life and the experience which living enables any individual to accumulate. The value of formal education lies in the fact that it is systematically applied at a plastic period, although no such education can effectively replace actual experience, which is only the wider education afforded by real life. This value is enhanced by the consideration that the environment of the school is easily controlled, and, if necessary, changed, while other influences on the mind and body are not so amenable. The obvious practical importance of these two factors of heredity and environment is seldom actually realized. Every teacher and employer knows that differences in capacity between different people are very great. Many boys are incapable of reaching the same point in a certain subject during education as another who may have an especial "bent" in this particular direction. At the same time, there are few who are of such poor mental calibre as to fail to follow some branch or other with some measure of success. The existence of hereditary differences, resulting in variation in aptitude, makes it vitally necessary to select the vocations of the boys and girls leaving school, so that the talent peculiar to the individual shall have an opportunity of manifesting itself. At the same time, while hereditary influences play a great part in determining the character of an organism, an even greater part is due to environment, the attempt to control which we call education. The fact that education plays such a large part in developing latent tendencies renders it essential that once a vocation has been chosen, adequate training should be supplied. These two phases of selection and training are complementary, and one cannot be neglected without serious injury to the other. It is futile to train a worker for a vocation for which he is inherently unfitted, and it is wasteful to train only partially suitable, ill-chosen material. Good selection is valueless if not accompanied by appropriate instruction.

Opposing Educational Theories.—So far as modern education is concerned, the antagonism between the opposing theories of Froebel and Herbart may be traced to the relative importance attached to the factors of heredity and environment. To Froebel is due the classic simile of a child as a plant, developing from within according to immutable laws. The teacher has his valuable office cut down to "benevolent superintendence," while he watches the child grow. The Herbartian system lays great stress on the importance of education in forming the man. The supply of ideas to the mind and their organization must be carefully performed if active harm is to be avoided.

Modern educationists find their most fruitful and suggestive theories in the philosophy of Herbart, thereby tacitly acknowledging the supreme importance of education as an active agent in child development. On the other hand, the value of the kindergarten is also realized, but the child is not allowed to develop alone as much as Froebel's philosophy would appear to suggest. Thus due account is taken of both factors, this being the state of affairs which common sense and experience would direct in an educational system without assistance from educational theory of any kind. The main consideration, so far as the industries are concerned, is whether, and how far, primary education develops those qualities which are necessary in industrial life. In order to do this it is desirable first to decide what qualities are necessary, so that the effectiveness of the educational system in developing them can be investigated, and if necessary, more rational methods which permit such development may be suggested.

Individual Characteristics.—It is convenient to divide individual characteristics into three main groups:—

1. Normal characteristics present in every adult, necessary in everyday living and in the observance of common social obligations.

2. Characteristics desirable in all individuals engaged in manual occupations.

3. Characteristics desirable in the skilled artisan engaged in the engineering industry.

The first group comprises mainly those qualities under the headings of health, strength, and character. These are essential to all men and women, and naturally their development should form the basis of any sound system of education. All productive work is seriously handicapped if the worker is subjected to any periods of inactivity or partial activity due to ill-health, and this is particularly to be deplored if the cause could have been remedied at an early stage. It is sometimes found, too, that many desirable qualities in a worker are vitiated by the presence of some undesirable moral quality, such as intemperance, lack of honesty, laziness, mendacity, unpunctuality, etc.

The second group of characteristics includes additional ones necessary to manual workers, who require a certain amount of co-ordination between hand, eye, and brain in order to work effectively. Kerschensteiner considers that there may be many vocations, preparation for which would not need practical training, because this would never be required; such is the case with some of the learned professions.[1] There are, however, many instances in everyday life where a little practical training is of the utmost value, quite apart from its beneficial effect in developing the physical organs. In the case of courses of study for the so-called learned professions, practical tasks add variety and balance to an excessively bookish curriculum, and so prevent a one-sided development.

Specific Artisan Characteristics.—Broadly speaking, the worker who is to be a skilled artisan should possess the characteristics of the second group, but much more strongly marked and more completely developed.

It should be noted, before detailing other desirable

[1] Kerschensteiner, "Idea of the Industrial School," translated by Pintner, p. 24.

qualities, that the majority of trades do not demand the whole of them, while some demand a few only. Different occupations may require qualities which are contradictory, such as cannot be found in a single individual, which again emphasises the necessity for careful choice of a vocation. Separation and grouping of the qualities required in each trade has not yet been attempted, except in a very general way.

Physical Fitness.—In view of the extreme importance of good health, this may again be mentioned. Every boy who enters industrial work should be strong and in good physical condition. While the strain of engineering works life is easily withstood by such boys, those not so fitted readily show their deficiencies in this direction, and tend to become dissatisfied without clearly realizing the cause; any boys of slight build who may not be sufficiently strong to take up physical work constantly, are well advised to seek some other avenue for their labour. It is thus evident that on this ground alone the heavier industries must be recruited from the sturdier families of the artisan population, particularly of the north.

General Intelligence.—The peculiar character of skilled engineering work demands the very highest degree of practical intelligence available, and among present-day workers the most valued men are those of the acutest intelligence. It is not possible to define very clearly this elusive capacity for "seeing" things and doing them in a rational way, but it involves what is often called common sense or judgment, and is readily determined by an observant employer after a man has been working for a short period. It is to some extent innate, and can be tested in other ways than by the actual performance of work in the shops. This characteristic is treated at greater length in Chapter VIII.

Manual Dexterity.—The special quality of a highly skilled artisan is a co-ordination between hand, eye, and brain, which enables him to do skilled work rapidly without any waste of time and effort due to uncertainty in the response of the hand to the directive brain. This co-ordination confers on the worker manual skill or dexterity, and is only obtained after constant practice and long experience. At the same time, there is no doubt that some people, whose proclivities are primarily motor, possess a special aptitude for acquiring this skill, while others, primarily sensory, find exceptional difficulty in doing so. The former group are therefore adapted for skilled work much better than the latter, and should be definitely selected to this end. The greater the degree of accuracy in the work required, the greater must be the co-ordination, and hence the greater the skill required. Since the principles of standardization and interchangeability adopted in modern engineering demand a very high degree of accuracy, it follows that there is great opportunity for highly skilled men in the industry; in some cases, however, the introduction of machinery has facilitated working to a high degree of accuracy, and skill is only required in testing the work, rather than in actually producing it. This, however, does not diminish the necessity for highly skilled workmen but permits the introduction of labour of a lower grade—in respect of experience and intelligence—on automatic and semi-automatic machinery.

Mechanical Instinct.—This characteristic and valued quality of British engineers appears to consist in a sixth sense by which errors can be rectified, although there is no superficial indication to show that anything is wrong. A designer may alter radically a carefully calculated design because it "looks" wrong. This instinct can only be acquired after long experience in actual practice, and since the training of the early engineers was solely practical, they possessed it to a supreme degree, and it is of undoubted value. The long practical training of the workman puts him in an exceptional position to cultivate it, especially if he understands the principles of the processes he undertakes and has a clear idea of the relation between causes and effects as he meets them.

Delicacy of Touch.—This is a valuable faculty acquired by many workmen, and in some trades is extremely necessary. In the case of a moulder, a very light touch is required in repairing moulds without damaging them further, while fitters and turners are able to feel irregularities in surfaces that cannot readily be seen with the eye. Among electrical workers, instrument makers may be cited as having to perform exceedingly delicate manual operations.

Adaptability.—The present crisis has shown that adaptability is a most valuable quality in a workman: not only has war necessitated an adaptation of machine to a different kind of work, but many workmen have been compelled to adapt themselves to entirely different conditions. The British workman, as a general rule, is intensely conservative, suspicious of innovations, and not inclined to sympathize with progressive changes. This inertia handicaps the whole industry in its development, and any elasticity of mind which the men may naturally possess is artificially destroyed by the restrictions imposed by the Trade Unions; this tends to a mental atrophy which unfits a man to undertake any work other than that single branch which he is accustomed to follow, which in its turn results in discontent, due to monotony. The abandonment of this policy and introduction of a suitable system of training would result in much greater flexibility of the works organization.

Co-operative Faculty.—Modern industrial conditions demand that men should work not as independent units but in mutually dependent groups; this team-work is essential to success and involves a high degree of co-operation. Some men are able to work with others without friction, but others fail to do so, and inefficiency is introduced by a man who may try to pursue an independent course if his work is part of a carefully designed scheme of production. Allied with this is a capacity for following specific direction in working. Few men require to be directive solely, without being at the same time dependent, because increase in executive responsibility means increased responsibility to others. Experience in some men develops a directive capacity for linking up the efforts of others to produce maximum result. Thus industrial work demands a high degree of discipline from all workers.

Pride of Achievement.—In the mediæval period, the distinguishing feature of all manual work, compared with that of the present day, was the love of work which men possessed, coupled with their pride in accomplishing it satisfactorily. These features to-day are sadly lacking. It is generally considered to be difficult to restore the older ideal of the relation between a man and his work, but it is not impossible; one of the most beneficial changes in industrial work would be the introduction of conditions which foster growth of love of work and pride in it. It is particularly unfortunate that the average youth who at the school-leaving age has the constructive instinct well developed and is anxious to enter into practical life and earn the right to independence, has his early enthusiasm damped by the unmistakable evidence of the inferior status accorded to manual workers, a condition partially due to the inflated regard for book knowledge which obtains in the schools. Towards the formation of a new mental attitude school life can do much, and with it would come an interest in work which would result in the consideration of it not as a means to a material end, but as an end in itself, the production of sound workmanship and solid, persistent effort in its accomplishment.

Capacity for Spontaneous Attention.—A skilled worker requires to be able to concentrate his attention readily on work in hand without allowing the mind to wander. Specialist workers sometimes require to have a clear definition of a number of things simultaneously; where speed of working is a primary consideration, this faculty is very important.

Instinct for Appraising a Number of Conditions Conjointly.—When dangerous conditions arise, much may depend upon what course of action is taken to meet the emergency; some people, when faced with such conditions, seem to suffer a complete nervous paralysis of the mind and are able to do nothing. Others pursue a course which, on mature reflection, does not prove to be the most favourable one, while few seem to possess a capacity for appraising the totality of factors, and immediately to do the right thing. In many kinds of industrial work the last type is, of course, the best, for with other men disastrous consequences may ensue. In some callings workers might be of the first type without their efficiency being impaired.

Rapidity of Thought and Action.—In all circumstances, even when rapidity of action following on thought is not essential, it is desirable that it should be so, thereby avoiding sluggishness.

Memory.—While retentive memory is not essential, a trained memory which can be used as a tool is desirable. It should be selective, retaining that which is important and dismissing unimportant details.

Capacity for Learning by Experience.—Some people apparently fail to learn fully the lessons of experience. This is exceedingly undesirable in industrial work, for while an initial error may be pardoned, subsequent ones due to the same cause are indefensible.

Observation.—The necessity for careful observation has been repeatedly urged by educational writers, but it is useless to expect boys to look at things which they do not understand, and to "observe" them. If boys are to observe carefully, they must be first taught to know what they should see, which again emphasizes the necessity for thorough vocational training. The observation which is valuable is that which involves notice of effects in order to appreciate causes.

Neatness.—A most desirable quality in works life is neatness and tidiness of work and person, because slovenliness, especially in work, means in the long run a great waste of time and material, whereas neatness facilitates the attainment of the necessary accuracy. Every good workman is not only neat, but thorough, and a close examination of his work should not reveal a merely superficial finish but solid workmanship throughout.

Economical Working.—The economical use of material, particularly some highly expensive materials used in electrical engineering practice, is of great importance, and much may be saved by making workmen realize of what magnitude the costs actually are.

Miscellaneous.—Acute sight is occasionally necessary, more so than hearing.

Youths occasionally possess characteristics which are undesirable owing to their results, such as impulsiveness and a tendency to want to move about from one place to another. Deliberation and the desire to settle invariably come later.

CHAPTER IV.

EXISTING EDUCATION IN ITS RELATION TO INDUSTRY.

THE English educational system presents a bewildering variety of schools supplying the community with boys and girls, but the supply of labour for industrial work comes almost wholly from the primary school, and to a much lesser, although increasing extent, from the secondary school.

Primary Education: Kindergarten Period.—In his "Educative Process," Prof. Bagley conveniently divides the primary school into three parts, corresponding roughly with the three periods of child development. From the time of entry into school till about the age of eight, the education of a child takes place frequently in a Kindergarten, on lines advocated by Froebel, and revitalized by Montessori. This often coincides with a "transition period" of rapid growth and susceptibility to fatigue and disease, during which, therefore, the pace is in no way forced, and every care is taken of the child's growth. The Kindergarten itself expresses an advance on the part of educational thinkers in pedagogic method, for formal methods of instruction are absent. The child mind reacts to the external environment without any restrictions, and the motor activities are allowed full play. Any harmful fatigue, mental or physical, is precluded by the ease of transition from one subject to another. Careful study of psychological processes has resulted in the introduction of methods of instruction more in harmony with the child's mind, facilitating the teaching of reading, writing and arithmetic. Interest and curiosity which children have in outside things is utilized to the full, and their co-operation in the process of learning obtained.

Formative Period.—From the age of eight to twelve, which is a "formative period," drill methods remain in vogue, and these do less harm at this period than at any other; growth is slow, and a surplus of energy is available which can be used to decided advantage in habit forming and learning. The play period as such ends, and an increasing desire for purpose in activity stimulates the growing boy cheerfully to undergo the monotony and discipline of constant practice. At the age of twelve, those boys and girls in English schools who intend to proceed to secondary schools take the entrance examination. The rest, who constitute the large majority, remain at the primary school until they are legally able to claim exemption. The fullest value is seldom made of these concluding years, and it is at this point that the greatest change in the future may come.

Adolescent Period.—The period eleven to fourteen marks the beginning of adolescence, of physically rapid growth and emotional instability. In its general lack of equilibrium, this period resembles strongly that of the ages six to eight. The boy begins to live freely in the adult world, is moved by motives similar to those which actuate adults, and strong desires to achieve some objective results manifest themselves. It is this longing to do something which urges the boy to take up some definite work, and it might be possible for a careful student of the boy's school career, leisure, and home life to decide tentatively in what occupation he is likely to succeed.

Manual Training.—The only work that boys do which approximates to practical tasks is that obtained in the manual training school, which forms a centre for about half a dozen or more schools, pupils from which attend for one half day each week. Grants are payable in respect of this instruction for boys over the age of eleven, and hence attendance is confined to boys between eleven and fourteen. It is only under very favourable conditions that the course for each boy lasts three years, owing to the fact that limited accommodation may preclude attendance before the age of twelve. The withdrawal of boys on their fourteenth birthday, which may be before the end of the school year, also cuts short the course in the majority of cases, and is an excellent reason for the full and continuous use of school accommodation. The materials employed in the manual training school are invariably wood and metal; in each case, small articles are sketched, drawn to scale, and made by each boy. The models made have some utilitarian value, and, subject to good workmanship, become the property of the boy. Lessons on the materials and tools used are given. Metal working is much less frequent than woodwork, because, although equipment is cheaper to maintain, the material is more difficult to work. No attempt is made to teach a trade, and this fact is carefully impressed on the boys themselves, who, however, persist in finding a relationship between the practical work and trade instruction, an impression which cannot remain long after entering industrial work.

Those boys who proceed to the municipal secondary school obtain a broader general education than is possible in the primary school. A modern foreign language, generally French, frequently either Latin or German, experimental science, etc., are added, and greater facilities exist for physical exercises and games. Many boys leave these schools long before the complete course is over. It is not uncommon to find boys of fourteen who have had two or three years in a secondary school, but who have left on arriving at the normal leaving age, although parents are required to agree to keep their boys there for at least four years. If the only discernible aim of the primary school is to prepare a few boys to take the secondary school course, even more completely is the aim of the secondary school to prepare a select few for the entrance examination to one of the universities. The insistence by the latter institutions on an entrance examination, the prestige gained by the secondary school when it can display a large number of successes, and the peculiar efficiency of the academic machine in preparing children for examinations, render the secondary school liable to attach undue importance to matriculation demands, although the merest fraction of the students proceed to the university for higher education.

Central and Higher Elementary Schools.—In many large towns, schools known as higher elementary schools or central schools have been established for the purpose of enabling boys and girls to obtain a training which will fit them to some extent for work after the school period is over. In London about fifty of these schools are now open, and others are contemplated; some have an industrial, others a commercial bias, and, provided the Board of Education is satisfied regarding certain minimum requirements, the remainder of the curriculum may be varied according to the industrial needs of the district in which the school is situated. Admission is confined to boys and girls in their eleventh year who have reached the fifth standard, and the course is planned to last four years. In the commercial schools, modern languages, book-keeping, shorthand, typewriting, and commercial correspondence form part of the curriculum, while the other group lays stress on mathematics and elementary science, no less than twelve hours weekly being devoted to some form of practical work in the laboratory or workshop. It is extremely difficult to say what degree of success attends the work of these institutions, and impossible to state how far the process of selection for one type of school or the other is satisfactory, or how many children remain in the branch of work for which they are trained. It should be noted that the age of entry and length of course make them practically secondary schools, so far as they provide for children between the ages of eleven or twelve to fifteen or sixteen. If their work proves to be successful, it is to be expected that they will attract pupils to the exclusion of the secondary school providing a more general education.

How far Primary Education develops Artisan Characteristics.—On analysing the education provided by primary schools in the light of the artisan qualities already outlined, it is clear that there is a distinct failure materially to improve the physical condition of their scholars. It may indeed be doubted whether the harm resulting from confinement in a school desk for over five hours each day is seriously counteracted. This passive condition cannot fail to produce evil results at a period when every fibre of a boy's being calls for activity, whether it be play or the purposive activities of adolescence. There is no reason why opportunity for games should be withheld from primary school boys, since it is considered necessary for others. The cramping influence of the classroom and lecture theatre is mainly responsible for the excessive regard for games characteristic of our higher schools and universities. A more balanced curriculum, a curtailment of time spent in passive attention, due recognition of the physical factor would, paradoxically enough, result in enhanced regard for purely intellectual tasks. In after life, the tendency to spectacular games would be contested, and the whole physical tone of the workers raised.

Except for the short period of time—two or three hours—spent each week in the manual training school in the higher standards, and for a similar period in some occupation in the lower standards, no opportunity is afforded of obtaining general manual dexterity, or of establishing those co-ordinations of the organs by which it is acquired. The constructive instinct is left to manifest itself in play periods in a haphazard and unorganized manner.

The gravest indictment against the elementary school lies in its utter failure to develop the co-operative faculty. This would seem to be the most striking difference between such schools and the preparatory and public schools utilized by the wealthier classes. Not only is it important from an industrial point of view that a capacity for team-work be encouraged, but also from the wider standpoint of citizenship. Absence of games is doubtless responsible in the main, but there is a general lack of *esprit de corps* about the whole of primary school life. The difficulty of maintaining Old Boys' Associations is an indication of this.

Pride of achievement is, and will probably continue to be, lacking until manual work is restored to its old dignity. Much can be done in the primary school to inculcate real love of work for its own sake, because of the genuine pleasure it brings.

Too little opportunity exists for boys to become acquainted with actual things, as distinct from pictures or descriptions, and in consequence there is little or no real knowledge of them obtained, which results in faulty observation. It is a common occurrence in everyday life that no two people will describe an object or an event in the same way, and not infrequently give accounts which are completely contradictory. There is also room in the primary schools for insistence on true economy. In industrial work the waste of material which goes on is often little short of criminal, workers seldom being consciously economical.

Finally, the primary school can do much to combat the tendency among workers to be proud of untidiness and dirt, not by a perfunctory insistence on external cleanliness but by a careful explanation of the consequence of slovenliness and dirt in promoting disease, both of body and mind. This could be radically altered for the better if the school-leaving age were raised, since at present boys leave school at the very age at which they are most likely slavishly to follow the example of other workmen, instead of assuming full responsibility for what they do.

Evening Continuation Schools.—While some early efforts were made in England to provide evening school instruction for the purpose of supplying lamentable deficiencies in general education, no serious steps were taken in the direction of industrial education until 1859. In this year the "Science and Art" Department instituted the well-known examinations for teachers in science and other subjects. The effect of the 1870 Act was to produce a decrease in evening school attendance; but after the Technical Instruction Act (1889), continuation schools, as they are now known, began to be established. The most notable recent feature of evening school development is the introduction of the "course" system, by which students under a specified age and degree of attainment are required to pursue certain related subjects in a course, instead of isolated subjects. The system, which has been applied with a degree of elasticity, has undoubtedly been very successful, and has resulted in a much broader knowledge among less advanced students, admirably paving the way for greater specialization later. Much greater co-ordination between different but allied subjects has been rendered possible. It is particularly noticeable that the percentage of students who complete a grouped course, and who are in full attendance at the end of the session, is much greater than that of those who follow isolated subjects. The general nature of the course adopted depends upon the student's actual or intended vocation, and may be technical, commercial, or domestic. The students are, in the main, skilled and unskilled workers in the industries, clerks and other commercial workers, with a few home workers. Artisan students follow technical courses, which provide instruction in those sciences bearing on industrial work.

There is little doubt that with the increased provision of instruction bearing on the occupations of the workers, the older type of continuation school affording instruction in general subjects, such as music, singing, elocution, gymnastics, ambulance work, citizenship, etc., has been neglected. Some of these subjects are provided for in domestic courses, others by private schools, but in general, the increasing efficiency of the primary school and the improved facilities for private study through cheap text-books, libraries, correspondence courses, etc., may be held responsible for the decline.

Technical Education.—The system of evening continuation and technical schools in a large city has now great ramifications. The instruction often commences at a lower level than the average attainment of boys and girls leaving school partly in order that students who for any reason are not advanced enough to take normal classes may not be unduly handicapped; partly because many youths do not attend evening classes until some time after the school-leaving age has elapsed, and thus have forgotten most of their school work. The latter cause is rapidly being remedied by a system whereby boys commence attendance, free of charge, at an evening school at the beginning of the session previous to the date at which they are to leave school. This plan would be considerably facilitated if boys were compelled to remain at school until the conclusion of the academic year in which the fourteenth birthday occurred, or if withdrawals were permitted once every half year only.

A boy leaving school and entering a works takes a preliminary technical course, consisting of practical mathematics, English, elementary science, and drawing, generally held in the primary school buildings. Subsequently, higher courses embodying mechanics, heat engines, machine construction, electrical theory, etc., may be studied at branch technical schools which feed directly a large central institution. In most schools instruction in both mechanical and electrical branches is provided, but in the early stages the course is common to both. Specialization in either branch follows later, and a full course of study may occupy six or seven years or even longer.

Junior Technical Schools.—Within the last few years institutions recognized by the Board of Education as junior technical schools have been formed. These schools provide two or three years' instruction for those boys proposing to become skilled workmen, who leave the primary school about the age of twelve in order to pursue this special course. The instruction has a distinct practical bias, but no trade specialization is attempted. Wood and metal are generally chosen for workshop instruction, and the schools in many cases arrange the curriculum to suit boys proceeding to the engineering trades. There are about a score of such schools now open, of which the L.C.C. Beaufoy Institute, Lambeth, is an excellent example. The usual school subjects of English, history and geography, mathematics and freehand drawing are retained, with elementary science, geometry, machine drawing, and wood and metal work added. The whole of the curriculum is dealt with in an exceedingly practical manner. Fees of 30s. per annum are charged, and the full course covers three years.

Trade Schools.—As will be shown later, the expression "trade school" is, strictly speaking, incorrect, unless it affords facilities for obtaining manipulative skill as well as a knowledge of the principles of the trade. No trade school can possibly arrange to do this effectively. Such as exist do not pretend to confine themselves to one trade only, but prepare for a variety of trades, and afford workshop practice in wood and metal work. The Stanley Trade School, Norwood, is an admirable example in England, and is the only one specifically built for the purpose. The work approximates to that of the junior technical school.

Other Schools.—It is impossible to leave this subject without referring to the excellent work accomplished by training ships, industrial schools, reformatories, orphanages, schools for mentally and physically defective children. Starting in many cases with admittedly poor material, these schools confine themselves to a few things which are fundamental, and one of the essentials is the learning—as far as trades can be taught outside a works—of some definite trade. The results, speaking generally, are amazingly good, and if they can be obtained under these conditions, there is every hope that a course of trade-teaching for normal children would be equally beneficial.[1] Not only would the moral tone of boys be raised, but industry would be permanently benefited and unemployment lessened; only then would the complaint

[1] The Artane Industrial School of Trades, Dublin, is an excellent example of a school for normal boys who have no proper home.

of an American writer, that to be taught a trade a child in the States has to become a criminal or a lunatic, be devoid of application to Great Britain.

Continuation Education in the United States.—In the United States evening school education has not been developed to anything like the extent obtaining in Britain, but such schools are found frequently in or near industrial centres. Suggestions have recently been made that schools corresponding to junior technical schools or higher primary schools should be formed, providing literary, commercial, manual arts, or household arts courses, according to the ultimate vocations pupils elect to take up.[1] Two-thirds of the time would still be devoted to normal school subjects. Such intermediate schools, it is argued, would relieve the pressure on the high schools due to those students who feel the need for instruction beyond the elementary grades, but who fail to complete the high school course.

The Fitchburg (Mass.) school is managed on these lines, and is attended by one-third of the pupils whose degree of attainment is that of the concluding grades of the primary school. Mentally retarded children are specially provided for in other such schools, and these pupils gain enormously by having work to do which is within their mental powers, of which great use can be made later.

The Gary Plan.—The interest in the life of the schools which is taken by the American people is much greater than that held in either Great Britain or Germany, and this interest is reflected in the constant reference to school topics and developments appearing in the press. When a talented and enthusiastic educator is working in an American city, it frequently happens that, backed by a strong spirit of public confidence, he

[1] See "Handbook of Vocational Training," Taylor, p. 67.

is able to work astonishing reforms in a very short space of time. Among the places which show evidence of this development is the small township of Gary, Indiana, where Superintendent Wirt has introduced an entirely fresh system of school organization. He commenced with the advantage of entire freedom from any existing system and of any traditional methods, and his efforts have attracted widespread attention.

The Gary school consists of, in addition to the usual classrooms and playground, a garden, workshop, social centre, and library, together with other adjuncts such as a school farm. All grades of education from kindergarten to high school are found under one roof, this completely bridging the gap between the primary and higher grades, in addition to being economical in administration. Further, the school is a self-contained unit, not a mere aggregate of grades.

One half of the school time in each day is spent with a normal teacher in the regular studies, the remaining time being occupied with special activities in connection with manual and industrial work in workroom or garden, gymnasium, laboratories, or playground. Great economy in equipment is secured by arranging that while one half of the school is engaged in the classrooms, the other half is occupied with the other activities provided for in the time-table. Thus for eight classes, only four classrooms are required. The normal studies, arithmetic, history, geography, reading, writing, spelling, etc., are done in two periods of ninety minutes each day, one in the forenoon, the other in the afternoon, while the special activities also receive three hours daily, divided into four periods. Thus the school equipment is fully used the whole of the working day, which is longer than is usual. On Saturdays and at other times the school is open, and pupils, if they choose, may attend and work or play as they please. Four evenings each week the buildings are open as a continuation school and as a social and recreative centre.

A marked feature of the arrangement is the attempt made to solve the problem of vocational training. Instead of employing workers during long vacations to carry out school repairs, a much smaller force of men of good character, intelligence, and skill is employed permanently, and pupils work with them. School furniture is made, stained and finished, buildings are painted inside and out, and the heating, lighting, and ventilation plant, motors, clocks, and bells, etc., afford wide scope for teaching practical work. In fact, the plumbing, printing, and foundry and machine shop work required is done in this way, and the purchase, care, and distribution of stores of all kinds is managed so that it affords training in business methods.

The school playground contains a garden and garden-house, and pupils build houses for their animals.

The teaching is departmentalized, so that work in music, gymnastics, gardening, etc., is carried on by specialists, and to a limited degree the same system applies to the regular studies, where the subjects are split up between two teachers. Promotion is made not by advancement in grades, but by subjects. A physically defective child may spend the whole available time in outdoor activities until strong enough to profit by the normal work, while a child backward in any special subject is able to suspend temporarily some work while he attends the class in his weak branch.

Alternatively, the work may be done on Saturdays. Thus the curriculum is adapted to the pupil, and not vice versa.

Twelve miles east of Gary is a model farm of 160 acres, where boys may learn agricultural work or dairy farming, earning more than enough to board themselves while doing so.

In connection with the activities of the school as a recreative centre, a branch of the public library with an assistant in charge is installed in the school, and special literature teachers co-operate in cultivating and directing juvenile reading.

Although the cost of providing a school on the Gary plan is about two and a half times more than the usual school plan, the greater degree of organization of the former permits the attendance of a much larger number of scholars, so that the cost of instruction per head is little more than half the normal amount. The cost of operation and maintenance, although actually doubled, is, owing to the greater capacity, much less than half, while the cost of instruction per head, in spite of generous salaries and small classes, is about three-fourths. Thus the Gary plan considerably decreases the cost of education, and results in a school of much greater efficiency. At the same time it enters fully into the life of pupils, and becomes to them and their parents a vital reality instead of remaining a thing apart. Ultimately, the school management may administer public libraries, art galleries, museums, public parks, and every other educational agency provided by the municipality, which will result in most effective use combined with the greatest possible economy.

The advantages of the Gary system may be summed up as follows :—

1. All teaching is done on a departmental basis, which is educationally sound, and which requires teachers for ordinary academic studies, for the practical work, and for physical training, music, and other special subjects.

2. Clear differentiation is made between the imparting of information and the training of character.

3. Full recognition is granted to the need of pupils for self-activity, the play-impulse being ultimately transformed into the work-impulse.

4. The enormous increase in the capacity of school buildings through simultaneous use of all classrooms, workshops, playground, garden, gymnasium, swimming pools, etc., results in great economy. Active co-operation is instituted with other educational agencies, public library, church, social settlement, recreative centre, with economy and efficiency where these are actually managed by the school.

5. School buildings are open during evenings and week-ends to scholars, and in certain parts to the public.

6. Play as an educational factor is recognized and suitably organized.

7. Vocational selection is accomplished in a measure by allowing boys to work out, with suitable skilled workmen, practical tests involved in the operation and maintenance of the school buildings.

8. Promotion is made by subject, and not by standard.

9. Great flexibility of organization is secured in adapting work to exceptional children, which diminishes the necessity for special schools for defectives.[1]

10. Better attention is given to the health of the scholars, who are expected to gain physically just as they gain mentally.

11. The co-operative faculty is developed in the special activities.

12. The gap between the primary school and the high school is eliminated.

[1] The report to the London County Council by Mr. C. Burt on defective children is interesting in showing how far special schools are justified for the children who occupy them.

CHAPTER V.

READJUSTMENT OF PRIMARY EDUCATION TO MEET INDUSTRIAL NEEDS.

IN the early history of the race, the main aim of instruction was to place the growing boy in possession of the experience collected by his forefathers. During the Middle Ages there was a direct relation between the intended vocation and the preceding training. The Renaissance was responsible for the introduction of the classical ideal in education, and it undoubtedly did good service as long as educated men were men of leisure, but it brought with it a contempt for trade and manual labour which still lingers. In another age, which has made education compulsory for all, or at least practically free to all, it is clear that all traces of that contempt must be eliminated.

Weakness of Existing Education.—All members of a modern community should serve it by the performance of useful work, and since the majority will undertake manual work, the system of education should not fail to inspire a real love of work for its own sake, if the welfare of the community is to be advanced. That modern education does so fail, is due to the fact that it is bookish and pedantic rather than vital and practical. This is the main reason for the mutual distrust existing between business men and educationists. The former do not always realize the inherent disadvantages of formal instruction of any kind, and may assign to the school responsibilities for results which are primarily due to the home, the street, or the playground, or to any other environment by which the growing boy is influenced. There is often too much inclination to expect a finished product. Further, there is a distrust, generally well founded, of classroom instruction, which results in the excessive and arbitrary stress sometimes laid by business men upon the value of concrete experience. This is accentuated by the fact that teachers fall readily into an academic groove, and their teaching fails to reflect the great world outside which is so full of interest to boys. Hence, also, the irritation often felt at school work, since the boys are unable to appreciate the motives of the adult who is teaching them.

Educationists, on the other hand, condemn the business man for the material purpose which he would impose on education, and aim at supplying the higher needs, neglecting entirely the others.

Utilitarian and Cultural Aims.—This antagonism between the "utilitarian" and the "cultural" aims of education underlies every controversy relating to educational reform. No one would dispute that the various branches of knowledge and training which produce the cultured mind should be placed within reach of all children, irrespective of social position, but it would also be granted that a knowledge of how to make a living is necessary before it is possible to use knowledge of how to live. The benefits of true culture cannot be realized by any individual who is not able to work, and thereby to ensure a competence. The fact that many boys and girls who have received a good primary school education are unable to turn this into account in earning a living is the most potent argument in favour of a change.

Education for Social Efficiency.—These apparently antagonistic aims must be reconciled in education for social efficiency, which includes and harmonizes them both, since a socially efficient individual will learn not only to make a living, but also to advance the general welfare of the community. Educationists, in the main, do not understand the requirements of industrial work, and therefore it will be necessary for them to obtain the co-operation of people engaged in industry. It should not be difficult to arrive at a common basis of agreement. Business men and employers should bear in mind that there is nothing to be gained by early specialization; that the best foundation for life is the broadest foundation; that life is greater than merely earning a living. The educationist aims, rightly, at producing a complete man rather than an industrial machine, and if he seldom succeeds, it is not altogether his fault. He should remember, however, that the huge majority of boys and girls, after leaving school, will have to prepare to earn their livelihood, so that they should regard work not necessarily as a thing to be shunned. The power a boy or girl can wield comes, not of knowing, but of applying knowledge, and no one who is untrained is able to reap the full benefit of previous education. Nothing causes so much personal regret to an adult worker as a feeling of impotence due to lack of special training, and when this feeling comes, it invariably comes too late to be remedied.

If a critic of the primary school curriculum examines closely the actual subjects taught, he finds little he would willingly omit, and the method of treatment is improving steadily. History and geography are taught more rationally, and local illustrations are sought. The bugbear of grammar has been considerably modified, arithmetic is more practical, and domestic science deals with the phenomena of common life and is becoming more experimental. The striking feature of primary school education compared with that obtained at the higher schools, namely, the lack of provision for physical training, which is confined to spasmodic physical exercises for about an hour each week, or a few minutes each day, has already been referred to. There is no open space provided except the asphalted playground, and no half holiday for games. In some places this deficiency is receiving attention, and in Birmingham, for instance, organized games for school children are being developed in the city parks and open spaces.

The Educational Ladder.—Of the system of education as a whole, the prevailing impression gained by the authors is that Huxley's ideal of an educational ladder from primary school to university has been too completely realized. In fact, the general form of the ladder is present even when the rungs are missing. Every stage of educational effort is preparatory to the one which succeeds it, and has little or no independent value in itself. In the large majority of cases, the succeeding stages are never realized, and thus much of the preparatory value of the first stage is lost.

The following approximate figures indicate the smallness of the proportion of primary school scholars who proceed to institutions of higher education, and they constitute sufficient condemnation of any scheme of education which is continuous from primary school to university :—

Number of children on the registers of primary schools	6,000,000
„ „ such children in actual attendance . .	5,500,000
„ „ „ „ in rural areas . . .	2,000,000
„ „ „ „ between the ages of 11 and 14	1,700,000
„ „ children between the ages of 12 and 17 .	2,000,000
„ „ „ in attendance at secondary schools	174,000
„ „ these children who come from primary public schools	110,000

It will be seen that one child out of ten obtains secondary training, or about one primary school child out of sixteen. The proportion of primary school children who obtain a *free* secondary education is about one in thirty. Since the percentage of secondary school scholars who go to universities is about three, the probability of any primary scholar who is unable to afford secondary training obtaining university education is about one in 1000, or $\frac{1}{10}$ per cent. Less than 18 per cent of our secondary scholars obtain any form of higher education, and of these more than 10 per cent become teachers.

Figures for the cost of education may be of interest :—[1]

Cost of primary school education per head per annum	£4
Cost of secondary school education per head per annum	£10
Cost of evening school instruction (half of which consists of salaries)	£2,000,000
Total cost of existing system of education (1913) .	31,000,000
Cost of local and central administration	2,000,000
Local expenditure on elementary education . .	25,500,000
„ „ „ higher „ . .	5,000,000

The cost of education is rising by £1,000,000 each year.

That the difficulty is equally pronounced in the United States is evident from figures given by Mr. Taylor in his "Handbook of Vocational Education".

Of the pupils who enter the primary schools, 4 per cent leave before reaching the fourth grade, 9 per cent

[1] The "Times" Educational Supplement for October and November, 1915, from which the majority of these figures are taken, asks for the introduction of compulsory secondary education. While the advantages of present primary education are not so obvious as to invite expenditure on further training of a similar nature, the authors are in full sympathy with the suggestion that the senior departments of primary schools should be completely reorganized and placed on a new footing, and that if this could be done primary school buildings may be modified to meet the end in view.

during the time spent in the fourth grade, 13 per cent in the fifth, 14 per cent in each of the sixth and seventh grades, and 13 per cent in the eighth grade, leaving only one-third to complete the course. There is a similar state of affairs in the high schools and colleges. The net enrolment in the high schools of New York in 1913 was 61,262. The numbers discharged during the same year without completing the course were:—

First	year	12,535
Second	,,	4,963
Third	,,	1,929
Fourth	,,	899

Primary school education has no utilitarian aim, but is directed to the needs of a few who proceed to institutions for higher education. Since a number of children leave about the eleventh year for the secondary schools, there is a realization that they ought to be able to pass the examination necessary for entrance. Those who do not choose to do this, or who fail, remain at school until they are legally exempt from further attendance. Thus the value of these concluding years is largely lost.

The aim of the secondary school is equally specialized since it is restricted by the requirements of the university entrance examinations. The upper forms of many secondary schools consist in a matriculation class, although the number of pupils passing on to the universities is the merest fraction of the total number taught. This may explain, to some extent, the leakage which takes place through the withdrawal of pupils from such schools before the end of the course, because both parents and pupils must become convinced of the uselessness of such education. The desire for a school leaving certificate could be met by a more general application of school inspection by local university authorities. This would at once relieve the schools from the tyranny of this examination, and pave the way for making secondary education an end in itself—as far as any education can be so—with sides analogous to the classical, modern, and army sides of a public school. The English public school is in fact a secondary school, but reference is made here rather to the municipal and county secondary schools which have developed in recent years, and from which a number of boys pass to some extent into industrial and commercial work.

Suggestions Regarding Primary Education.—In view of the fact that it is from the primary and secondary schools that industrial workers will come, the provision of means whereby the attention of boys and girls during their final school years is seriously directed towards the needs of their future life, is of considerable importance. It is in the primary school where most immediate improvement can be made. In most English schools, boys may enter the ex-seventh standard—the highest class—before their thirteenth birthday, sometimes two or three years before. There is no special equipment or staff provided for this group at the top of the school, and it is therefore clear that great waste is involved in keeping them at school. A teacher cannot attend to the needs of two separate classes, i.e. VII and ex-VII, without seriously neglecting one of them. It might be possible to bridge over the gap between school and after-life in the following manner.

If vocations followed by school boys and girls are analysed, they may be classified thus:—

1. Industrial—mainly boys.
2. Commercial—boys and girls.
3. Domestic—mainly girls.
4. Agricultural—boys only.

Group 1 would include those boys intending to become skilled workmen, and group 2 those intending to enter the commercial world. Broadly speaking, these should be the most intelligent of the boys available, and to commence 33 per cent or more of the existing Standard V may be made into an industrial VI standard, and a further 10 per cent into a commercial VI. The remainder would form a general VI, and would be available for providing boys for less skilled occupations. The two new standards could then pay special attention to vocational needs. While about two-thirds of the time available would be devoted to general subjects as previously taken, the remaining third would with advantage be used in subject-matter of particular interest to each special class. The "industrial" boys would pay more attention to mathematics, elementary science and manual training, the "commercial" boys to commercial arithmetic, business correspondence, etc. The aim would not be to specialise, but rather to emphasise those particular subjects which would be most valuable later. For the time being, only future skilled workmen might be placed in the one class, those for the better class commercial work in the other. Youths entering other industrial occupations not demanding a high order of skill and intelligence, or those entering transport work, would remain in the general class. Although new equipment and classroom accommodation would be required, the best plan would be to adopt existing buildings for the purpose, so that no break occurs in the primary school period. A rather different type of teacher would be required, with a special training.

Such a scheme of training, to be successful, must take into consideration the number of men who are engaged in various skilled industries so that there may be some relation between the total of existing workers in any branch of industry and the number in prospect in normal times.

Considering the number of males who are at work in England and Wales and noting those employed in the main industries, it will be possible to state with some degree of accuracy what proportion these will be of the total number who come from the primary schools.

The following figures are adapted from Mr. N. B. Dearle's "Industrial Training":—

TABLE A.

OCCUPIED MALES OVER TEN YEARS OF AGE—ENGLAND AND WALES.

		Number employed.	Per cent employed.
1	Government	248,624	2·16
2	Defence	205,817	1·8
3	Professional occupations . .	367,578	3·2
4	Domestic work	387,677	3·4
5	Commercial occupations . .	666,499	5·84
6	Conveyance and transport . .	1,399,394	12·2
7	Agriculture	1,140,515	9·95
8	Fishing	25,139	·22
9	Mining and quarrying . . .	1,039,083	9·1
10	Metals, machines, implements, and conveyances	1,477,097	12·9
11	Precious metals, watches, instruments	99,931	·87
12	Buildings and works of construction	946,127	8·25
13	Woodwork and furnishing . .	253,802	2·22
14	Brick, cement, pottery, glass .	134,714	1·17
15	Chemicals, oil, soap . . .	135,113	1·18
16	Skins, leather, etc. . . .	83,472	·73
17	Printing and paper . . .	219,651	1·92
18	Textile fabrics	571,411	4·97
19	Dress	439,115	3·84
20	Food, tobacco	913,565	7·98
21	Gas, water, electric, and sanitary services	102,239	·89
22	Other workers and dealers . .	597,102	5·2
		11,453,667	100·00
	Unoccupied	2,197,535	

It will be seen that the largest group of workers (group 10) is engaged in the engineering trades, which account for about 13 per cent. Transport workers amount to 12 per cent, agricultural workers 10 per cent. miners 9 per cent, building trades 8 per cent, commercial workers 6 per cent. These six groups account for nearly 60 per cent. of the total employed males, or, assuming that the primary schools provide about 9,500,000 workers, about 70 per cent of this total. The remaining trades attracting most workers are printing, domestic work, woodworking, and those engaged in the manufacture of food and clothing. The branch which would repay most immediate attention is the engineering industry, which is localized in a relatively small number of centres. While, however, most of the greater industries are carried on in definite areas, a consideration which renders the vocational bias of any school fairly easy to create, it is not so easy to decide how many are required for skilled work in these areas, because it is difficult to say what proportion of men in the great industries are skilled workers. A further table by Mr. Dearle indicates that at least more than two millions may be put down as skilled manual labour. Group A in addition includes a number of skilled men, similarly Group C (chauffeurs, etc.).

Allowing for wastage, an army of skilled workers of three millions requires to be built up, which is nearly one-third of the total number of men supplied to the industrial world by primary schools. About 6 per cent of boys might also be added for commercial work. If to this total are added those who will take up clerical employment in connection with transport the percentage would be considerably increased. This total would account for nearly one-half of the existing numbers, and clearly indicates that the proportion of boys needing special training is substantial enough to warrant its provision.

TABLE B.

OCCUPIED MALES OVER TEN YEARS OF AGE. ENGLAND AND WALES.

		Per cent.
(A) Agriculture, textiles, mining, metals, salt, and alkali industries	2,670,732	23·3
(B) Clerical employment	767,447	6·7
(C) Higher branches of labour other than manual (Police, Chauffeurs, etc.) . .	535,272	4·7
(D) Skilled manual labour	2,194,803	19·1
(E) Semi-skilled manual labour . . .	1,408,812	12·3
(F) Unskilled manual labour	1,384,619	12·1
(G) Distributive trades	1,506,608	13·3
(H) Employers	438,915	3·8
(K) Army and Navy, mercantile marine, teaching, etc.	536,459	4·7
	11,453,667	100·00

Disadvantages of Present Attempts at Pre-vocational Education.—Of the existing schemes for pre-vocational education, such as those embodied in the junior technical, higher elementary, and trade schools, a number of objections may be raised, as follows:—

(*a*) The removal of a pupil to a new school causes a break in the primary school education, although this work should be the natural end of primary education, and as such is best taken in the same school.

(*b*) In most cases fees are required, thus debarring many deserving children whose parents are not able to afford the money required. Any form of industrial education will defeat its object if it is not free.

(*c*) The number of such schools required for all districts to be associated with the primary schools is very large. The initial outlay is great, and it would be simpler and much quicker to adapt existing than to create new facilities, and thus avoid an unnecessary multiplication of institutions, grants, and costs.

(*d*) Owing to the inevitable tendency mentioned above, to provide for those best able to care for themselves, there are attempts to turn out, not workmen from these institutions, but men who will rise to higher positions. While this may be a laudable aim in itself, this result would mean the duplication of other facilities available for this purpose. Trade Schools pride themselves on turning out boys who will rise to positions above the bench, whereas this is not the function of a trade school. Thus the new institution is in danger of becoming another unnecessary link in the chain.

(*e*) The work could be done equally effectively in the elementary schools if suitable teachers were provided.

(*f*) A wholesale removal of boys to another school at the age of eleven, even if free instruction is provided, might be the cause of objection from the parents.

(*g*) It might be difficult to relate the junior technical to the central schools already established in some areas, although both schools serve the same purpose—that of giving a vocational tendency to primary education.

These two types of school appear to be unrelated in their attempts to solve the same problem.

It is therefore suggested that the elementary school is the proper place for the development of such a scheme as the promoters of the junior technical school have in view.

The Failure of the Evening Continuation School.—The system of evening schools is, of course, open to the grave objection that a youth who has been at work for about nine and a half hours each day is too fatigued to absorb instruction during the evening, and this doubtless accounts partially for the relatively small proportion of those young men engaged in industrial work who attend such classes. The remaining objection, which is far more important and less fully realized, is that the tuition given, at least as far as the engineering trades are concerned, is of a character utterly unsuited to the needs of students who should attend the schools. In considering this question, it is necessary to dispel many pre-conceived notions. Accepting the division of workers into technical and manual given in Chapter I, the application of science to practice is now so wide that those who desire technical employment find it necessary to undergo a prolonged period of specialized training, such as is obtained at the universities and colleges which have a separate provision for engineering. When engineering practice was empirical, it was possible, as pointed out in Chapter I, for manual workers to rise to technical employment solely by virtue of their practical experience. In providing for the exceptional few manual workers who are able to rise to technical employment, the technical schools of to-day offer admirable courses. This channel is very desirable, and should be retained. An upward mobility has always been characteristic of British engineering, and to any youth of talent success has always been possible, but this condition of affairs tacitly neglects the needs of the huge majority of men engaged in the lower branches of industrial work who expect to remain permanently engaged in manual work. The percentage of men who can advance is very limited, and only the exceptional man on the bench can hope to proceed far. Such men should have opportunities of gaining the necessary foundation in the earlier part of their lives at a university, in the same way as those who are more happily placed financially. Then the technical schools could perform their proper function—that of providing instruction for the artisan student,—the exact nature of which will be considered later. Prof. Findlay declares[1] that a vocation

[1] "The School," by J. J. Findlay.

has its prestige enhanced by being embodied as the central feature of an educational scheme, and that the craftsman teaching his craft is compelled to become a liberal educator. An institution for general education should not pretend, he says, to qualify for vocational tasks. But the technical school has deliberately sacrificed liberal aims and all the value of a broad general training, without coming into any vital relationship and contact with industry. Hence it stands condemned for having failed to realize what should have been its primary aim. The attitude of the Board of Education is, however, sensibly changing towards artisan instruction, and a recent memorandum [1] reflects this.

While advanced technical work is retained in major courses, special provision is made for artisans in minor courses. A singular feature of the memorandum is the desire of the Board to retain old, rather than to alter to suit new conditions of apprenticeship. While there is a good analysis of mechanical trades, there appears to be no provision for the electrical trades, except for wiremen. Electrical fitters and assemblers, armature winders, and instrument makers are not considered.

The ineffectiveness of the evening school system, whether the fault lie with the school or with the individual, is shown by the fact that there are 1,500,000 of ex-primary school scholars between the ages of fourteen and seventeen who receive no education at all. The number of boys from fourteen to eighteen who attend evening classes in Manchester is about one-fourth of the total possible, and of the girls about one-eighth.

Use of Apprentice Day Classes.—Many technical schools provide day classes for apprentices in certain trades. Such classes are useful in enabling boys to avoid the strain of evening instruction, and if care is taken to admit

[1] Circular No. 894.

only those boys who can make good use of the instruction, the classes fill a very useful function, and may be regarded as a working compromise between the necessity for day courses for such apprentices and evening technical classes.

Readjustment of Education.—The readjustment of education to suit industrial needs may be made on the following lines:—

Instead of the further establishment of junior technical and central schools, primary education may be modified in the manner suggested, and so provided with an independent value and definite aim.

Evening schools will to some extent still be required for those ambitious youths who have the capacity to rise to technical employment, but evening schools of the more elementary type will require to be superseded by other institutions, both on account of the fatigue attendant on such evening study, and the general unsuitability of it to the mass of workers.

This newer kind of instruction for potential craftsmen should preferably be given in a school attached to the works undertaking the training of apprentices, on the lines more fully dealt with in Part IV.

There is no reason why even small works should not provide such educational facilities, although the concentration of industries in definite areas undoubtedly facilitates the development of a school serving a number of firms on a co-operative basis.

PART III.

VOCATIONAL SELECTION.

CHAPTER VI.

VOCATIONAL SELECTION UNDER PRESENT CONDITIONS.

THE selection of a vocation is the most significant step in a youth's career, and a matter of considerable economic importance to himself and to the community, yet it is made every day under the most haphazard conditions under the influence of circumstances which, instead of being secondary only, are allowed to become determining factors.

The Boy.—It is almost impossible for a boy to decide with any degree of success what he is fitted for, even if he is aware of the broad distinctions between industrial and commercial employment. His imaginative faculties and lack of experience are likely to lead him to build on false hopes and according to incorrect values.

Every one is familiar with early speculations regarding an ultimate vocation which change later to the often secretly nursed and more permanent desires of adolescence. It is scarcely possible to overestimate the keenness of many boys to leave school, to do as adults do, and live independently as they live. By choosing a vocation in the light of an immature judgment in complete ignorance of what it demands, this fine enthusiasm, which if rightly guided would be worth so much, is damped, and the boy grows up to early manhood, that commonplace of life, a square peg in a round hole. His work lacks the interest which it should have and he becomes a source of discontent. Among the factors which contribute to this undesirable state of affairs may be mentioned the proximity of industrial openings to the home, the influence of school companions, easy working hours or other conditions, the tendency to wander from one situation to another, his father's occupation, and temporarily high wages in situations which offer no prospect of adult employment. Any of these may decide what occupation is taken up, small consideration being given to the fundamental question of inherent fitness.

The Parent.—The choice of the parent is open to equally grave disadvantages, and although there may be no illusions as to the nature of industrial conditions, parents are usually quite unable to estimate the requirements and prospects of more than one occupation, that of the father. Statistics of the percentage of youths who follow their father's occupations would afford a valuable side-light on industrial employment. While formerly quite common, the practice of allowing a boy to take up his father's trade has declined considerably, except in certain industries and among men who have small workshops of their own. This is doubtless due to a more widely spread desire among parents that children should secure a better position in life than they themselves enjoy, and occasionally to an active dislike on the part of a workman for his trade. The former view, while quite laudable, does not allow for the progressive improvement in working conditions, and, taking this into account, the decline is somewhat regrettable, because a boy brought up from infancy in a home where the parent follows a certain vocation cannot fail to become imbued, in a measure, with the trade "atmosphere," and the peculiar features of the trade are more readily transmitted.

It is only on this supposition that it is possible to explain the peculiar suitability of certain kinds of skilled labour to the local industries, and this forms a distinct argument in favour of the centralization of industries in certain areas. Sometimes, however, this tends to increase the objection some workers have in refusing to allow their children to follow their own occupation because of the increased risk to the family if trade depression causes unemployment. In the main, however, such depression tends more to affect unskilled workers.

The view of a parent regarding a suitable occupation may also be vitiated by an extravagant conception of a boy's capacity. The earnest desire of some parents or guardians to do the best possible service to the youth tends towards an over-anxiety to place him in a calling of a clerical nature. It is scarcely necessary to say that this is in many cases the worst possible avenue open to any boy who avoids "blind-alley" employment. Others, realizing their lack of knowledge of the requirements of various occupations often seek advice from equally uninformed and inexperienced sources.

The School.—The only remaining agent in vocational guidance is the school, and this is unsatisfactory because the school teacher is apt to lay too much stress on book-knowledge and to deprecate the possibilities of industrial work. A clever boy is thus directed to an office rather than to a works, although it is in the latter sphere that native talent is able to force its way ahead most rapidly. Further, teachers as a body lack experience of industrial work and conditions, and are unable to estimate rightly the requirements of different vocations, owing largely to the complexity of openings available. It is therefore evident that while in a few instances careful attempts may be made to select a vocation to suit the bent and qualifications of the boy, too often the selection is made on such superficial grounds that by far the majority of boys entering industries do so under extremely fortuitous conditions. The main consequence of this, combined with the decline of the apprenticeship system, is the "blind-alley" occupation and its concomitant evils.

The result of these haphazard means of selection may to some extent be offset by the general adaptability of many youths to a variety of occupations, and to the fact that the mechanical trades possess in common several broad principles which operate in rendering the number of bad misfits less than might otherwise be the case. While this is fortunate in view of the considerations which may prevent entry of a boy into a given occupation, such as the condition of trade, nature of local trades, etc., it must be admitted that every real misfit is economically disastrous to the individual, and, in the long run, to the nation, so that the existence of even a small percentage of such cases makes remedial attempts justifiable, and the replacement of empirical by scientific methods necessary.

The Juvenile Employment Bureau.—Within the last few years strenuous efforts have been made in England to deal with the problem by legislation, in connection with which alternative schemes are possible.

Under the Labour Exchanges Act (1909) the Board of Trade was granted powers to establish advisory committees for juvenile employment as were considered expedient, and which consist of a chairman, representatives of employers and workpeople (in equal numbers), together with other persons having special experience of young people and their education, such as teachers, social workers, etc. The function of such a committee is to "give advice with regard to the management of any labour exchange in its district in relation to juvenile applicants for employment," and "to take steps to advise and assist boys and their parents in the choice of employment". In a subsequent clause the more ambitious scheme adopted later was foreshadowed. This was the Education (Choice of Employment) Act (1910), under which local educational authorities were able to acquire statutory powers to work a scheme of juvenile employment with the active co-operation of the Board of Trade, acting through a special local branch of the Labour Exchange. It is clear that the Labour Exchange as used for adults does not in any way improve on existing methods of selection. It deals largely in casual and unskilled labour, in which there are applicants for a very limited range of employment. The chief business of the Exchange is to bring employer and applicant together without too much regard to previous experience of the latter, provided age and character are suitable. This tendency of the Labour Exchanges to fill vacancies of any character is exemplified by the following paragraph from the "Handbook for Local Advisory Committees for Juvenile Employment in London":—

". . . of the juveniles who register little more than half are found employment. The remainder find work on their own account and nothing more is known of their careers. . . . a policy of declining to fill certain types of openings would have an unfortunate effect on the influence of the Exchange. The Exchange should aim at dealing with the whole of juvenile employment. It is useless for the Exchange to refuse to fill these [blind-alley] types of openings."

Coupled with the admission that one-half of the boys leaving school enter "blind-alley" employment, and that, at most, one-third enter skilled employment—figures which do not materially differ from year to year—it is impossible to hope that the normal Labour Exchange can in any way act advantageously in directing suitable applicants to skilled work.

In connection with the above act, however, a much more systematic plan is followed with both boys and girls.

The local education authority appoints a special juvenile employment sub-committee consisting of members of the local Education Committee, together with representatives of local employers, workers, and teachers' associations, and other members who have particular knowledge of the conditions of child-life and training, especially those connected with local social welfare organizations. A special juvenile labour exchange is set up in charge of an officer of the Education Committee. Children prior to leaving school are put into touch through head masters and the education authority's office with a visitor whose work is voluntary, and who makes a rough classification of children, according to whether their circumstances demand that they should have no attention, some attention, or considerable attention. The first group comes from good homes where the parents act judiciously on the child's behalf. The second consists of children from the mass of artisan homes, where parents, though well-meaning, fail through ignorance to realize what is best for the child, and who therefore require guidance in the exercise of their function. The remainder who are neglected or ill-treated, and who require special and constant attention, come from homes which are bad. The visitors proceed by paying friendly visits to homes, making their inquiries in a tactful way, and their visits are generally favourably received. A boy or girl who has no definite plan for a vocation is promptly put in touch with a special local juvenile employment bureau, in charge of an officer of the Education Committee. Parents may take their children to the bureau for advice on vocational matters. The bureau co-operates to some extent with employers, and many children are successfully placed in the occupation they desire. Needless to say, "blind-alley" occupations are strongly discouraged, and attempts are made to follow up cases where the boy or girl leaves the situation provided.

At the same time visitors lay stress on the importance of continuation study, of thrift, and often put "unattached" boys and girls into touch with some organization, such as Sunday school, church, scout troop, etc., in which they may be interested and where leisure may be employed progressively to some objective. In this way the attractions the streets have for the aimless are dealt with, and valuable moral training commenced. These schemes are now growing to great size. In Birmingham, where 13,000 children leave school annually, there are over 2000 voluntary workers, every area in the city being systematically covered. Edinburgh, Bradford, Cardiff, and many other centres have developed similar schemes. About 120 areas are now definitely working on these methods, being almost equally divided between the two available. Birmingham, Bradford, London, and other towns have excellent handbooks giving details of their staple trades and industries, affording information which is most valuable to parents, and which give an idea of working hours, wages obtainable, whether the trade is healthy and whether seasonal, etc.

In Edinburgh a system of training for young people, which is referred to at greater length later, has been developed as a corollary to the scheme of juvenile employment. In most cities such schemes link up with existing local continuation education.

While these efforts cannot be praised too highly as distinct steps in the right direction, it must be admitted that much remains to be done. There is a tendency to get a boy *a* job as distinct from *the* job. It is extremely doubtful whether one man—even if he were able to deal with all the children who present themselves, and even if he had more information about a child than can be gleaned by a few minutes' observation and questioning, or from the information given by a visitor—could be so familiar with all industrial requirements as to be able to say definitely whether a boy is or is not suitable for the vocation he has in view.

CHAPTER VII.

SELECTION BY THE EMPLOYER.

ANY process of selection by an education authority must necessarily be tentative, and even under the most favourable conditions little more could be done than to indicate a certain range of employment in which the boy might find a place, because the equation of his personal characteristics to the requirements of a definite kind of work demands a knowledge of industrial processes not possessed by anyone outside industrial work. It has been pointed out that this definite equation is not fully applicable because other factors, such as the proximity of work to the home, the moral character of the boy, etc., may operate to prevent it.

The employer, since he knows in general the requirements of the post to be filled, is in a much better position than the education authority to determine specifically what occupation should be taken up.

It must be frankly admitted, however, that selection by the employer is scarcely less haphazard and casual than is the case even when the choice rests with the employee himself. Where any earnest effort is made by employers to select their juvenile labour, the methods adopted comprise one or more of the following:—

(*a*) Personal interview.

(*b*) References from sponsors.

(*c*) Appointment to the situation on trial or on probation.

(*d*) Occasionally, by some other test, such as a written examination.

(*e*) By a combination of these methods.

Personal Interview.—An employer frequently has the advantage of wide experience in meeting applicants and in interviewing them. He may be expert at appraising a man's worth by all the ways which can produce any results at all from such an unsatisfactory system, but his experience is unorganized and its value thereby partially lost. It accompanies him on his retirement and is not available for his successors, who thus have to go over the same ground again, a process which makes progress impossible.

Distant experiences vanish beyond immediate recall, thus involving the repeated commission of errors of judgment. Further, the employer may not clearly realize the true requirements of the work, or the type of man demanded, and the qualities of desirable candidates remain unexpressed. Sometimes the important work of interviewing candidates is delegated to a subordinate. Finally, the money and time of both employer and applicant may be wasted in an endeavour to determine whether the job is suitable or not by the applicant actually taking it up. The practice of selecting through the medium of a committee offers, for example, sufficient indication of the haphazard nature of existing methods in that the decision of a body of men is often less desirable than that of a single individual, because the cross examination seldom consists in more than a few unrelated and often irrelevant questions from members who in their final choice may be at variance. In any case the "short list" is carefully prepared beforehand by an official from paper qualifications. Such rule of thumb, uncertain methods, as far as they are based on anything at all, depend upon an aptitude, real or imaginary, for character-reading at sight, a gift possessed by very few individuals. The candidate is aware that much depends upon the interview, and very little chance is given the employer of learning anything the nature of which he is desired to remain ignorant.

References from Sponsors.—References are often designed by well-meaning individuals to further the candidate's interests without the strictest regard for accuracy, so that where they are considered at all they are not relied on solely.

On the other hand, if the boy is associated with the scout movement a recommendation from the scoutmaster may be considered an important point in his favour. The training in discipline that these boys receive, their intelligence and general knowledge, especially in practical tasks, form valuable qualities which should be instilled in every schoolboy, preferably through this or some similar organization.

A scoutmaster has exceptional opportunities of determining a boy's practical ability and common sense. Other boys' organizations do valuable work, but few have so captured the rising generation, as well as the general public, as that pertaining to the boy scout.

If the movement continues to be successful it will be of incalculable value, and the public might well echo Principal Griffiths in his desire to see its founder as Minister of Education for a term of years.

Probation.—The only remaining method is to accept the youth who seems to be able to adapt himself to the work without any glaring disability and to see how he succeeds. This trial period is often spent in a works under the eye of a foreman or other official who may be by no means best qualified to judge, and who is frequently biased by extraneous circumstances, especially by the demand for labour at the time the decision is made. If he is considered unsuitable, the youth is discharged and the operation is repeated elsewhere, more time and more money being lost in the process. Unless he is able to learn from experience for himself, he ultimately joins the ranks of the unskilled. More frequently, the demand for labour, lack of careful and able observation, and often favouritism tend to prevent conscientious selection being made, with the result that a youth may be trained until adult age, and then turned out as part of a very low class of skilled labour. Where the demand for youths is in excess of the supply, employers are too anxious to secure boys to make the requirements sufficiently exacting. Consequently, youths who are less keen on the work are attracted, and since these fail to repay careful training, the quality of training suffers, to the ultimate injury of the industry.

Employers and Education Authorities.—The tendency on the part of some employers to rely more and more on school authorities to provide them with the requisite material is also to a large extent responsible for obtaining an unsuitable class of youth. Employers fail to realize that teachers are to a considerable extent ignorant of industrial processes, and liable to value the bookish youth above the practical one, thus the very type least suited for industrial work is likely to be most highly recommended for whatever positions are under consideration. In some cities, notably Edinburgh, schemes of co-operation between employers and school authorities have been developed, and, subject to the operation of the tendency mentioned above, will doubtless have very beneficial results.

Since much in works labour may conceivably be performed by an intelligence of a very low order, the matter of judicious selection is unnecessary, but it is not always appreciated that the inadvertent inclusion of a better grade of intelligence is an economic waste if a low grade is reasonably sufficient for the purpose. In some cases, however, a better man is able to do the work less wastefully.

Cost of Indiscriminating Engagement of Labour.—Some striking figures regarding the cost of engaging and discharging employees were given in a recent address to an American manufacturers' association by Mr. Magnus Alexander.[1]

He investigated the state of affairs in twelve factories in six different States, employing either male or mixed labour, skilled and semi-skilled, numbering 300 to 10,000 on each pay roll, and fully representative of the engineering industry. He found that nearly three-quarters of the workers had not been employed at these factories previously, the remaining part having worked in the same factories during one or several previous periods. The total number employed at the beginning of 1912 was 37,274 and at the end 43,971, an increase of 6697. The number actually engaged during the year was 42,571, and the number discharged was 35,874, over six times as many being hired as were necessary to constitute the permanent increase in the roll. Making liberal allowances for death, prolonged sickness, voluntary resignation and discharge, local discharge due to building extensions, etc., and the imperfect efficiency of the employment bureau—put at 80 per cent—the number of hands engaged by this group of firms was no less than two and a half times as many as was necessary to increase the force by 6697.

The cost of engaging a man is given by different employers from $30 to $200, and is made up chiefly as follows:—

(*a*) Clerical work in connection with hiring.

[1] See "The American Machinist," August 21, 1915.

(*b*) Instruction of new employees by foremen and assistants.

(*c*) Reduced rate of production during early period of employment.

(*d*) Increased wear and tear of equipment by new employees.

(*e*) Increased amount of spoiled work by new employees.

Mr. Alexander gives several methods of cutting down this expenditure, of which careful training of labour is one, to which should be added the equally important matter of careful selection.

It will in future be necessary for the employer to choose his men with at least as much care as he expends on his tools and general workshop equipment, and, if necessary, to employ experts to assist in the work.

CHAPTER VIII.

SYSTEMATIC METHODS OF SELECTION.

THE adoption of a scheme of the nature outlined in Chapter IV, in which a bias is given to primary school education, would assist considerably in the development of a sound method of vocational selection. Much is gained by persuading a boy seriously to think about the work he will take up, since this tends to combat the policy of drift, and directs him towards a decision.

Determination of vocational fitness demands firstly, a knowledge of the personal characteristics of a youth, and secondly a survey of the requirements of the position to be filled. Where it is possible to equate these two, the situation may be considered to be filled in the best possible manner.

Individual characteristics can be settled from definite experience of previous work of the individual, or they may possibly be predetermined by psychological or physiological tests. The demands of various industrial posts may be decided by means of a large and comprehensive survey of the thousands of varieties of work found in industry. Several such investigations have been undertaken in the United States, assisted by the questionnaire plan so popular in that country, but recently Mr. C. R. Richards has emphasized the necessity for system and uniformity in this direction. His suggestions provide an admirable basis for future attempts. The field of vocational education covers the first of the three following ways in which the interests of workers may be advanced, the improvement of industrial efficiency by increased skill or trade knowledge, the extension of general education, the provision of facilities for recreation, physical and mental, to relieve the restricting influences of the daily work. This improved industrial efficiency may be partly due to manipulative skill, partly to trade knowledge, and since different industries demand these in differing degrees, the following division of different occupations may be made: those needing

(*a*) Both skill and trade knowledge,

(*b*) Skill, but not trade knowledge,

(*c*) Trade knowledge but not skill,

(*d*) Neither skill nor trade knowledge except in a very low degree.

Each industry can then be considered to see how far each factor can be supplied by the daily work, and what should be supplied from another source.

Further investigation would consider the opportunities presented to workers in the industry for advancement, such as by high wages, by steady rather than intermittent or seasonal work, or by the existence of a relatively large number of higher posts; the ways in which the industry is recruited, including particulars of the proportion of beginners to older hands, etc.; the ways in which the workers obtain training; the qualities demanded of each worker; the conditions under which work is performed, including the effect of work on the intelligence or morals of workers, the presence of deleterious physical effects, high mortality rate, etc.; the relations of the occupation to school training.

Some interesting facts have been elicited by Dr. L. P. Ayres in an investigation of this character. After examining the school systems of seventy-eight cities, it was found that children of thirteen years, the school-leaving age, were found in every grade from kindergarten to high school. More than half, however, were in the sixth grade or below. One father in six, and one child in two lived in the city of birth. These facts indicate the necessity for some means of retaining backward children at school until they are fitted to undertake definite work, and for a wider outlook on vocational education than that imposed by merely local industries.

An analysis of occupations yielded the fact that some are constant—common to every community—and in a fairly uniform proportion to the total population. Thus the existence of any municipality renders necessary certain occupations involved in the upkeep of public services, while vocations like hairdressing, house-painting, baking, printing, etc., will be found everywhere. In each of twenty constant occupations followed by men, at least one per thousand of the population was employed, and in some the proportion is much higher. Other occupations were found to be local and variable, being centred in certain areas and unpractised outside them, chiefly consisting in the manufacture of certain articles of food and clothing, in addition to other industrial products. The practical conclusion Dr. Ayres urges is that, other things being equal, vocational education should pay attention to the universal rather than the localized industries, although, on the whole, the demand for such education comes from the trades comprising the latter rather than the former.

Psychological Tests.—Psychological tests aim at predetermining those mental qualities which settle fitness or otherwise for a specific task, usually discoverable only after a period of probation. They may be utilized to select a definite individual for a definite line of work, or conversely. In the latter direction practically nothing has been done, but in the former it has been customary for many years to apply simple sensory tests in colour discrimination, etc., to candidates for some branches of navigation and railway work. A striking example of what may be done under some conditions in this way occurred in connection with the inspection of ball bearings at an American factory. Girls engaged on this work must have keen perception and rapid responsive action. By measuring the reaction times of the workers, Mr. S. E. Thompson was able to eliminate those who were naturally slow in response and in consequence the number of workers was reduced by more than two-thirds, the wages of the remainder increased to double, with a decrease in working hours, while a much greater accuracy of work was obtained.

Prof. Munsterburg has made several direct attempts to determine vocational fitness in connection with street-car drivers, ships' officers, and telephone operators.[1] His methods depended largely on whether the work demanded, in the main, a well-defined mental process or a complex variety of such processes and were as follows :—

(*a*) To test the mental processes demanded by the industrial work *as a whole*. This involves the construction of actual experimental conditions under which the total activity required can be performed in a measurable way.

(*b*) To resolve the mental process into its components and to test every single mental function or element in an isolated form. This involves the use of familiar tests of experimental psychology in every case treated in this way, which, of course, is the most convenient method to the psychologist.

Since it is necessary, however, to test the complete function as well as the elements of it, the first method has to be used in addition.

[1] "Psychology and Industrial Efficiency," Munsterburg.

At present it would be simpler to utilize the first method, since industrial work is very complex, and instead of constructing experimental conditions, to put the man on the actual work required, thus aiming at a general rather than a mathematical result. This virtually means that the method resolves itself into the existing one of probation, with the important difference that the period is utilized as a means to a perfectly defined end under a careful observer. A much shorter time would then be required to produce a conclusive result. Thus a man required for turning might be tried on a definite turning operation, and carefully watched for speed, accuracy, delicacy of touch, certainty of movement, concentration, and the other features which make up a good turner. Prof. Munsterburg advocates the erection of municipal institutes to undertake the work of selection on psychological grounds.

A very different American view of the function of psychology in this connection is given by Dean Schneider, author of the Cincinnatti sandwich system of engineering training, in a paper before the annual convention of the National Association of Corporation Schools, 1915. He examines various systems which have been used for vocational selection, the consideration of characteristics of boys as they manifest themselves in the various boy epochs, pseudo-physiological determinations (such as the shape or colour of various physical features), and the psychological method. The first method is said to be useless, because it is impossible to state which characteristics are persistent and which disappear, while the second proved exceedingly unreliable. The psychological method also suffers severely at his hands. He declares that the number of variables in a character makes scientific prophecy difficult, and that psychologists have not established any correspondence between test results and proved abilities. Most psychologists would object to the implied limitation of the science, and Dean Schneider does not say how far he is indebted to psychological analysis for the list of characteristics which he gives. Classifying them by antithesis, he declares that a man is "deliberate or impulsive," "directive or dependent," "roving or settled," etc. It is highly probable that two temperaments may be combined in one individual, with one predominating, and certainly may be present in the same individual at different ages. Many men in industry are required to be directive, but there are few who must be dependent as well. The desire for settlement and deliberation come with age and experience, and most men indicate the reverse characteristics early in life. Dean Schneider concludes that the only reliable method is to test the man by trying him on the job.

Psychological science should be regarded rather as placing our existing experience and knowledge on a rational basis, rather than as the application of some new and complicated tool to old conditions.

Owing to the fact that no tests have been developed for any trade at the present time efforts may most advantageously be directed towards the securing of a definite standard of general intelligence in youths entering a trade. Any adjustment with regard to the exact nature of the work done by any particular youth may then be made subsequently, an adjustment which is rendered possible by the plasticity of both the individual and the work.

General Intelligence.—The characteristics demanded in general by the mechanical trades have been set forth in Chapter I, and educational authorities should select for such work those boys of good intelligence who are fond of manual work. Tentative determinations of intelligence and personal characteristics may be made in the following ways :—

(*a*) By teachers and head masters in primary or secondary schools, or in manual training centres.

(*b*) By parents or other relatives, or guardians.

(*c*) By scoutmasters and others who meet the boy during his leisure.

(*d*) By employers during the probationary period in a works.

(*e*) By formal psychological intelligence tests.

(*f*) By physiological methods.

These methods may be considered *seriatim*. During the period from the ages of six to fourteen, there is ample and unique opportunity for a careful student of child-nature to watch development, and the possibilities of accurate intelligence determination are greater during the school period than any other, because the period is prolonged. The chances of realizing these possibilities under existing conditions are, however, remote. Large classes preclude individual attention, and a teacher is seldom with a given class more than one or two school years, so that the advantage of long associations is scarcely possible. Should the teacher's function develop towards a closer association with each individual child, with his home environment and his leisure, as well as with the classroom periods, the conditions may be more favourable.[1] At present, a teacher's determination of intelligence rests almost wholly on examination success, not on intimate personal knowledge, and a test of this kind conducted in the normal way, is at best only a partial criterion of intelligence. Boys with retentive memories tend to do better than others, and retentive memory is of little value in industry if other important characteristics are lacking. Examinations give little

[1] See "The Gary Plan," p. 45.

opportunity of displaying concrete knowledge, and general intelligence cannot be considered synonymous with mathematical ability. Since the normal teacher only sees the boy at his books, it may be possible to obtain a more correct determination from the teachers in manual training schools, who see him at occupations in which his intelligence has an excellent opportunity of manifesting itself. Further, the number of boys to each teacher—limited to twenty—enables the latter to get into more intimate touch with each boy, and he is thus able to say with much greater confidence and accuracy, whether the temperament and characteristics of any youth are such as would lead him to success in industrial work, and in what particular direction. The decision as to a vocation may be made in spite of the short time available, and is assisted by the complete absorption of the boy in his task, whether it be drawing or the manipulation of tools.

It may be argued that such determinations are preferably made by an independent observer, in the same way that school medical examinations are conducted by experts; this, however, renders it impossible to utilize the personal experience of the teacher, and involves the use of other methods described under the last heading.

Although parents have had exceptional and prolonged opportunities of watching their children when the latter are least conscious of it, they seldom make good judges, because of their often extravagant optimism regarding a boy's talents.

In default of systematic observation, much may be done by those who come into contact with the boy outside school hours, such as scoutmasters and officials of other boy's associations.

Trial on Probation.—The commonest and most wasteful method of determining fitness for any kind of work, is to give the applicant an opportunity of trying it. Although this method has been followed for generations in thousands of cases, there is no record of experience which has been collected in reference to it, and few people are wiser for it. Until it is possible to predetermine vocational fitness, and thereby settle the question, it may be suggested that individual employers attempt systematically to record their experience in engaging workers. It could suitably be commenced in isolated cases which lend themselves to such treatment. A situation which requires a few obvious characteristics in a worker might be taken, and these tabulated on a file card. As soon as an opportunity occurs to fill the position, the characteristics of the applicant may be tabulated as far as they are discernible at an interview and through references. Subsequently, the degree of satisfaction the candidate gives in the work done could be noted, together with any unexpected feature, such as the outcrop of a special quality previously overlooked. Experiment on these lines will ultimately result, not only in a full chart of the requirements of each situation, but an increased knowledge of the best manner of interviewing candidates for it. It may at first be easier to do this for technically employed men than artisans. The following personal characteristics are tabulated by one large American company, in connection with the technical training of their future staff : physique, personality, knowledge, common sense, reliability, open-mindedness, tact, initiative, attitude, originality, industry, enthusiasm, thoroughness, system, analysis, decision, English, and ability.

Psychological Methods.—It must be admitted that all methods of selection are based ultimately on psychology, however inadequately the mental characteristics may be determined by the usual methods adopted at interviews, and the transformation of existing haphazard methods into systematic scientific ones virtually produces a psychological method, which aims at being definite and specific instead of vague and general. The adoption of some such method involves primarily a determination of the candidate's "general intelligence," which experience shows to be a fundamental requisite. No final definition of this attribute has yet been put forward, and the few which have been made are not satisfactory. Binet has defined it as a capacity for voluntary attention; Titchener as a general, innate, sensory discrimination. The psychological determination of intelligence has received much attention from Mr. C. Burt, psychologist to the London County Council, who defines intelligence as "inborn, all-round mental efficiency".[1]

The determinations are made by a series of tests specially designed to afford a comparison between various mental processes, and when the results enable a relative estimate of intelligence to be arrived at, their validity is tested by comparison with empirical estimates of intelligence by teachers who have long been acquainted with the children under test. The sensory tests give practically no ground for belief that they had any connection with intelligence, while the tests involving reasoning processes give an order which correlated with that furnished by teachers.

Thus Mr. Burt was able to conclude that "the higher and more complex the mental process tested, the more completely do the experimental results correspond with empirical estimates of intelligence," and he inferred that general intelligence is a single fundamental capacity pervading all the mental activities. Since it was found

[1] "Experimental Tests of Higher Mental Processes and their Relation to General Intelligence," "Journal of Experimental Pedagogy". See also "British Journal of Psychology," Vol. III, Parts I and II.

that parentage influenced the faculty, it may be to some extent innate. Psychologists are far from applying these principles to industrial processes. As yet the tests scarcely aim at discovering any specific faculty, but rather at assessing general intelligence from a variety of tests. In any case the determinations are relative only, no absolute measurement being yet possible. Further, no single test is sufficient to give reliable results.

Physiological Methods.—Some firms in America use a method of selection elaborated by Dr. Katherine Blackford[1] which has a physiological basis. Prospective employees are submitted to an examination of their physiological features, and from the evidence disclosed by this and by answers to questions asked at the interview certain inferences are drawn which assist in deciding for what employment the applicant is likely to prove suitable. The business of engaging workers in any plant is concentrated in the hands of specially trained experts, who utilize a carefully designed organization to secure smooth working with the factory executives. The method depends upon the theory that all physical and psychical traits are the result of a long evolutionary process, and that the evolution of the physical nature has been coincident and synchronous with that of the psychical nature. The correspondence which this implies between physical and mental traits is the basis of Dr. Blackford's plan, in which definite correlations are set up between certain mental characteristics and certain physical features. In short, instead of attempting to define these mental characteristics from psychological tests, they are foretold from the texture and contour of the physical organs. Nine fundamental

[1] See "The Job, The Man, The Boss," by K. M. H. Blackford and A. Newcomb.

physical variables are laid down as a basis for the character analysis—colour, form, size, structure, consistency, proportion, expression, and condition. A man is classified under each of these headings, whether he is predominantly blond or brunette, whether the form of the forehead, nose, mouth, and chin as seen in profile are prominent and protruding or concave and flattened, whether the face as a whole is convex, concave, or plane, and so on. From an investigation of the biological causes which are responsible for each type certain inferences are made which can be compared to a schedule of the requirements of each vacant post. "The normal blond has positive, dynamic, driving, aggressive, domineering, impatient, active, quick, hopeful, speculative, changeable, and variety-loving characteristics; while the normal brunette has negative, static, conservative, imitative, submissive, cautious, painstaking, patient, plodding, slow, deliberate, serious, thoughtful, specializing characteristics. . . . The less the pigmentation in any individual, the more marked will be the characteristics of the blond in his physical, mental, and psychical nature; the greater the degree of pigmentation, the more marked the characteristics of the brunette." Since there are many kinds and degrees of variation it is argued that there are corresponding varieties in character. Provided that the basis is scientifically established and experimentally proved—although decades of charlatanry impel many people to distrust physiological determinations—the plan would appear to be excellent in dealing with the men of all ages and types—especially the wide range found in America—who apply for employment and who would be difficult subjects for mental tests. With boys, who are immature, such methods would be more difficult and the psychological methods correspondingly easier.

Further, there are many qualities which psychological tests do not yet disclose, so that both methods may be used with advantage. The experience of one American concern is that one method makes up for the deficiencies of the other, so that they are complementary.

Each applicant to the British Westinghouse Company for apprenticeship is interviewed personally, and if education and health are satisfactory and the candidate desires to enter one of the engineering trades carried on at the works, he is placed in a department concerned with the trade. This first step is largely tentative. At convenient intervals, a group of such boys is tested partly by a scholastic and partly by a psychological examination, with a view to determining the relative intelligence of each member of the group. At present, psychological tests are held in order to test their validity, so that the progress of each member of the group will be carefully watched, and if, after a period in the works, the position of each on a list in order of intelligence corresponds roughly with that obtained by psychological examination, the tests may be used in future with confidence as a basis for intelligence determinations. The ordinary academic tests serve for the time as a rough guide. After a probationary period of about three months in the shops, if the Company is satisfied that the boy is suitable, and if he desires to continue learning his trade there, a formal apprentice agreement is made. If not satisfactory the period of probation is extended for a further three months, with a change of trade. Every effort is made to bring this period to a reasonable minimum, so that no valuable time may be lost to the youth. Letters of reference are frequently presented by applicants for apprenticeship, but it is found that they are of little or no value, those from head masters particularly being couched in similar formal terms, generally laudatory in a restrained and quite colourless way, totally failing to afford any real insight into the mind and character of the youth. A really original testimonial is rare.

PART IV.

APPRENTICE TRAINING.

CHAPTER IX.

EXISTING METHODS OF INDUSTRIAL TRAINING.

EVERY industrial community evolves a method of training juvenile labour which reflects in a measure the temperament and character of its people. The method varies according to economic conditions affecting the industries, and the degree of importance it attains depends especially on the extent to which industries are susceptible to international competition. The keenest competitors for international markets are the United Kingdom, the United States, and Germany, and in each of these countries the problem of preparing youths for industrial occupations has been undertaken on different lines.

The Position in England.—Apprenticeship as a means of industrial training has so long been established that in the public mind it stands for all that is necessary in the learning of a trade. The fact that in bygone times apprentices learned through practical work all that was necessary for the efficient pursuit of their future vocation, obscures in the minds of many the need for educational measures to proceed hand in hand with practical training, if the requirements of modern industrial conditions are to be satisfied.

As previously indicated, the attempt to provide early education subsequent to the 1851 Exhibition had a distinct industrial bias, but the effort was abortive owing to the weakness of general education. While in several directions spasmodic efforts have been made, partly by a modification of evening technical education or of primary education, also by the introduction of a few special schools, since then no comprehensive measures have been taken fully to grasp industrial requirements from an educational standpoint, and to provide means for meeting them. Efforts to modify evening instruction have, as already noted, recently taken the form of minor as well as major courses, the former to enable artisan workmen to get a better knowledge of their trade. The large majority of technical schools are as yet uninfluenced by the new suggestions. The junior technical school, which affords a modification of primary education, has also been considered. Of other special educational institutions, a few "trade" schools, those provided by reformatories, industrial and dockyard schools, etc., may be mentioned.

Works Schools.—Several firms in England have in the past caused classes to be held on their premises for the instruction of workpeople, but many educational efforts ceased with the increased facilities for study at technical schools. The work done at Messrs. Mather & Platt, Messrs. J. & J. Colman, and the Thames Iron Works Co. may be mentioned. There is no doubt that anticipations were held of the production of skilled workmen by the technical schools, but to-day the most earnest advocate of technical education would not argue that the schools were of any material benefit in this direction. Many employers who are in sympathy with continuation education make attendance of apprentices at evening classes a condition of their employment, but this practice is not to be recommended indiscriminately. Employers who feel a measure of responsibility for artisan training are able in this way to suppose that that responsibility is discharged by such attendance. Unfortunately this is by no means the case, owing to the unsuitability to artisans of much evening school instruction, and employers will be compelled to realize that their active support and interest in trade education is necessary before such education can be a success. While the idea of the works school is not new, at the present time its work has a new significance, and the failure of the technical school to train workmen suggests that the works school has to return as a permanent institution.

Cadbury Bros. Scheme.—In 1906 Messrs. Cadbury Bros. developed the well-known Bournville scheme whereby all young persons entering their works are compelled to be of a certain standard of attainment, and after entry to attend a continuation school for a specified period. The number of workers engaged in skilled occupations is only a fraction of the total number on the pay roll, consequently there is keen competition for vacancies in the apprentice courses, which are open to competition among suitable boys over sixteen. Trade classes relating to the various occupations are provided by the firm in addition to facilities for physical culture and swimming. All other classes are provided by the Birmingham Education Authority, the firm co-operating to secure the necessary attendance. Practically the whole of those who desire to become apprentices must have completed two years' evening school study before they are selected for one of the twenty-six skilled trades. Since the proportion of skilled workers is small, the scheme differs considerably from any which would be required in an engineering works. Suitable evening classes for semi-skilled and unskilled workers are arranged on a cultural rather than an occupational basis.

Scotland.—Industrial education has made more progress in Scotland than in any other country, with the possible exception of Germany. The controlling authority in the various areas is compelled, under the Education Act, 1908, to provide suitable continuation schools having reference to the crafts and industries practised in the locality for all young people above the age of fourteen. Attendance may be made compulsory up to the age of seventeen. Employers and parents have to co-operate in carrying these provisions into effect, the former being compelled to provide time for attendance at such schools, and to consider it as part of working hours. Specific day instruction is not demanded, but since the school time must be provided out of the working week, day instruction seems inevitable.

The most progressive city in the provision of trade instruction is Edinburgh, where a very comprehensive scheme covering a wide range of subjects in all grades is in operation. Pupils from fourteen to sixteen may take a course preliminary to higher courses in English, arithmetic, domestic subjects, drawing, woodwork, civics, hygiene, etc. A further group of classes for pupils over sixteen includes, in addition, more advanced subjects, mathematics, foreign languages, commercial subjects, etc. There is also a group of classes in cultural subjects, attendance at which is not compulsory, but the most important section consists in a course extending for three or four years, including expositional classes in trade subjects, practice in handicraft and trade methods in workshops, with appropriate auxiliary subjects, such as mathematics, mechanics, science, drawing, and design. Engineering and metal-working trades, building, cabinet-making, upholstering, coachbuilding, printing, baking, tailoring, dressmaking, etc., are provided for. Classes for each trade are under the direction of advisory committees consisting of representatives of education, employers, and workmen. Although not yet absolutely compulsory, 70 per cent of the young people in Edinburgh (11,000 out of 16,000), not receiving education from any other source, attend these continuation schools.[1]

United States.—The American nation has taken up the problem of industrial training in recent years with characteristic vigour, and several bodies, such as the Society for the Promotion of Vocational Education and the National Association of Corporation Schools have been formed to push forward the work of establishment of vocational education. Practically nothing has been done with regard to the scientific selection of workers, except that one or two firms apply Miss Blackford's science of character analysis (see p. 91). It is not easy to induce a free-born American citizen to undertake manual work in the factories, partly because of the foreign element present, and partly because the schools unconsciously foster the business spirit by the stress laid on the commercial side of the school work. In consequence, works have to fall back almost wholly on the foreign-born population, and of necessity classes have to be provided for instruction in the English language. It was thus a short step to the provision of schools in which other teaching of a vocational nature could be carried on. The lack of homogeneity in the working class population, the enterprise of works managers, the general freedom from custom and tradition cause a tremendous variation in the wage rates and working conditions, and the trades unions do not appear seriously to affect the disposition of labour. Many firms have a welfare bureau for the general physical well-being of the worker, which is a powerful factor in assisting the firm to discharge its responsibilities to its employees.

There are a number of schools teaching definite trades in various places, but in general, American primary and

[1] See a letter by Prof. F. G. Baily to the "Electrician," December 11, 1914.

secondary education in the most forward States offers problems not dissimilar from those obtaining in England. The tendency towards vocational education has resulted, in some quarters, in a desire to found separate vocational schools in place of the existing elementary schools, a policy which has been vehemently condemned by Prof. Dewey, who has been prominent in his efforts to revivify elementary education by introducing to it manual, industrial, and social activities.

In a large number of works, schools have been provided for the education of apprentices, and in many cases training workshops have been added, although opinion is divided as to the merits of the ordinary works or the special shop in training apprentices. Such schools have been established at the Pennsylvania, Santa Fé, and other large railway companies, the Westinghouse Electric and Manufacturing Company, the General Electric, Yale & Towne, Browne & Sharpe, International Harvester, Packard, Cadillac, and other large works. Instruction is given in the classroom for a few hours each week, and practical training is arranged under the supervision of an instructor or foreman. In those cases where a special training shop is provided, an apprentice often spends six months in this and then six months in the main shop, where his new knowledge is applied under commercial conditions; he subsequently returns to the apprentice shop, and learns another process or tool operation, and so on to the end of his apprenticeship. In the General Electric Co. the whole period of apprenticeship is spent in the classroom or training shop, and in the latter he is judged to have attained sufficient proficiency to proceed to new work if he can teach the boy who follows him the process to be mastered. A four year apprenticeship is becoming common in the United States.

Germany.—It is well known that Germany possesses a more complete educational system than any other country in Europe. To this the astonishing industrial progress of the German people during the last forty years is in no small measure due. Schools are available for the preparation of men entering all grades of industrial and agricultural work. Powers are given to local authorities to make continuation school attendance compulsory for all youths under eighteen, and employers are compelled to allow time for such attendance as the authorities may direct. Prussia had a compulsory education law a century before Great Britain, and the German trade schools of to-day are the result of a slow growth due to a now pervasive realization of the defects of the old school system.

In Munich the continuation school system has made wonderful advances under the guidance of Kerschensteiner. During the last year of attendance at an elementary school, boys are allowed to work in the trade school workshops during their half holiday, provided they attend a drawing class on the remaining half day (Saturday). On leaving school they are at once drafted into skilled trades, and are compelled to attend a trade continuation school for about eight hours per week for three or four years, this period generally coinciding with the length of apprenticeship, after which the youth becomes a journeyman, provided he has passed a qualifying examination. The subjects of instruction in each of the fifty trades consist of scripture, citizenship, German—subjects which are the same for all—trade calculations, trade information, and drawing, which, of course, are appropriate to each trade. Practical work is undertaken in the last two years, and then only for short periods.

It is most important to note that the trade schools do not attempt to impart manipulative skill, this being taught in the workshops. The final practical work of the schools aims at allowing boys to produce artistic work of a standard not possible under commercial conditions and to do the work necessary for the journeyman's certificate.

There are ten buildings devoted to this instruction, employing 150 permanent and 300 visiting teachers, the latter being normally engaged in following their occupations. Kerschensteiner's great achievement, however, does not consist so much in the provision of an organized body of schools with a common aim, as in the evolution of a rational conception of the trade school and its relation to the community. He frankly accepts the position that it is difficult to persuade many artisans to appreciate any instruction which has not for them an immediate and practical value, and courageously offers that kind of instruction which, by enabling them to earn more money, satisfies an ulterior and material desire on their part for advancement.

In its broadest conception, the plan provides for training in citizenship with a trade bias. No one who has come in contact with apprentices in a shop can fail to realize that many of them refuse to consider any form of instruction which does not bear directly on their trades, and the lower their intellectual level, the more does this feeling manifest itself. The only plan, therefore, of training such men is to accept this position and work out a scheme which takes the trade as its basis. The civic training which cannot successfully be given independently to boys will then be received quite well by youths in the industries, who, under ordinary conditions, would be antagonistic to it. Thus while trade instruction is of the utmost importance intrinsically from an economic point of view, it is of even greater importance as a medium for cultural studies and instruction in citizenship. The trade teaching develops a feeling of love of work accurately and conscientiously performed, and if followed by instruction in hygiene and civics, combined with gymnastics and games, forms an enduring basis for a sound democracy. The trade is taught, ennobled, and through it the whole of the community practising it is raised.

The result of this system is that in Munich all boys but about 8 per cent go to skilled trades. The "blind-alley" problem scarcely exists.

Those who, in spite of the system, persist in taking up work as messengers, young labourers, etc., are dealt with in special schools, where they receive instruction for four hours per week, covering the same course as is given to apprentices with the specific trade work deleted. In many centres classes are also formed for journeymen who are enabled to practise the higher forms of their craft, and work for the master's certificate—in the evenings or on Sunday mornings for employed, and during the whole week for unemployed workers. In some cases the teacher —who is, of course, a practical tradesman—and workers appear to assume the relation of employer and employed, the teacher purchasing the materials and selling the products to the general public. About one-fourth of the young men continue in voluntary evening classes, while among women the proportion is higher. Associations of employers assist in settling the nature of the trade instruction.

There are a large number of centres in Germany which deal with trade education on similar lines. Occasionally, however, the local authority recognizes a school attached to a company, and several examples may be cited, including Ludwig Loewe's machine-tool works, and Siemens & Halske's electrical works, both of Berlin.

Ludwig Loewe & Co.—This famous company has for some years undertaken a comprehensive scheme[1] of apprentice training, by means of a special school and a small workshop. The apprenticeship is of four years duration, and twice each year applicants with sound previous education are admitted to one of half a dozen trades concerned with the machine-tool industry. Those who desire to become technical engineers are compelled in Germany to take at least one year's practical training, before entering a technical college, and this company provides courses for such "maschinenbauvolontärs" of one or two years duration. Systematic practical training is given to the trades apprentices in the special shop for a year, where they make articles required in connection with the company's products. It is difficult to see how this work on a commercial scale can be reconciled with systematic shop work, since a logical series of exercises precludes economic execution of shop orders. Foundry apprentices are taught in a separate small foundry for two years, since it is found that foundry hands do not as a rule treat the younger boys very well.

The school for trade instruction is recognized by the Local Board, and attendance is compulsory. Classes are provided for each year of the apprentice course, in addition to three other classes, which are optional, for youths over eighteen who have not had training for skilled workmen, but who may become machinists (drilling and milling). Instruction is given on one whole day in the working week for each class and is confined to shop practice, comprising that which an intelligent apprentice would learn from a foreman if the latter had the time and ability to teach him. Drawing is considered a very important matter, and is taught in a special room. General classes in shorthand, French, and English are also provided for all workers.

[1] See "Technik und Wirtschaft," Dec. 1913.

For a considerable time all teachers were members of the works staff, but in view of their lack of training in teaching method, the company now employ six professional teachers, who are permitted to obtain the information they require from the shops. Nearly one-half of the lessons, however, are still given by the staff. About 220 apprentices and seventy-five other youths are taught, at a cost of £900 per annum, i.e. about £3 per head. When there were only half this number of apprentices, the annual cost was £5 per head. This firm finds that apprentices show a marked tendency to leave the works and seek higher wages elsewhere, but of these a number ultimately return. An exchange of apprentices is arranged with other firms who train apprentices to minimize this disadvantage.

Siemens & Halske.—In 1906 this company established a school, and in 1908 a workshop, for the training of mechanics who had previously obtained sound education and possessed good health. As with Ludwig Loewe & Co., the course lasts four years, preceded by three months probation. Sons of workmen and staff are admitted free, others pay a premium of £15 for the course, which goes to a workmen's benevolent fund. During the last two years, wages of 6s. and 9s. per week are paid respectively. Preliminary training is given in the training shop for one year, and apprentices return there for the last three months to make the piece of work required for the journeyman's examination.

All the teaching is done by members of the works staff, about twenty-four in number, to about 200 apprentices, who attend on an average nearly seven hours weekly for four years, classes being held in German, mathematics, book-keeping, drawing, science, electrotechnics, and law. Boys purchase their own materials at cost price from the firm. An outline of the syllabuses followed is given in Appendix II.

In general, the scheme resembles that of Ludwig Loewe & Co., except that the difference in the nature of the product—electrical appliances instead of machine tools—involves training some boys as electricians as well as those for turning, machining and ironworking.

Maschinenbau Atkiengesellschaft, Nuremberg.—About twenty-five to thirty-five apprentices—preferably workmen's sons—are admitted each year to a four year apprenticeship, preceded by two months probation. Foundry men, pattern-makers, and fitters are trained in separate shops by special foremen, and proceed to the other shops in the third year. Thirty-six hours per week in the first, forty-two in the second and third, and fifty-three in the fourth year are the prescribed hours, including those spent in school. Ten per cent of the wages is retained until the end of the apprentice period. It is interesting to note that both core makers and moulders are trained for the foundry, and that the latter are taught to make cores as well as moulds, in case it should ever be necessary, the apprentice moulder spending twelve months in the core shops before being transferred to the apprentice foundry.

General Methods in Germany.—A striking feature of German methods of training is the thorough manner in which apprentices are taught to appreciate the work of other trades. Thus Ludwig Loewe & Co. provide for the interchange of pattern-makers and moulders. Good moulders are sent into the pattern shop for two months, while pattern-makers, machinists, and fitters are placed for a few months into the foundry. Wolf's of Magdeburg send foundry apprentices to the turning shop. It is doubtful whether trade conditions in England would ever permit of this interchange, but if it were made, the traditional differences between pattern shop and foundry would tend rapidly to disappear.

Wages of German apprentices are, on the whole, considerably lower than those obtained under similar conditions in England. Several curious methods of payment are in vogue to induce workmen to teach the apprentice. In one German foundry, a moulder who trains a boy is allowed all the bonus that the latter earns on his work, thus encouraging the moulder to make the boy proficient as rapidly as possible. The apprentice receives about 3s. weekly. Gradually, however, the moulder loses this advantage as the youth becomes more skilled, and he begins to pay part or even the whole of the apprentice's wage. Finally, in order to retain the assistance of the youth, the moulder pays 1s. to 3s. per week bonus as well as the nominal wages. As in America, some firms make special arrangements to prevent departure of apprentices before their time has expired, such as the award of a heavy bonus at the termination of apprenticeship, or compulsory savings which revert to some fund if the boy leaves before a specified time.

Besides the practical training, there is instruction provided at a municipal continuation school or at a works school, the latter possessed by each of twenty or thirty firms. Nearly all the works schools make their classes centre round four subjects—drawing, trade instruction and materials, arithmetic, and German. This last generally covers civic instruction as well. In Dusseldorf 130 out of a total of 214 classes at the municipal continuation schools are specialized according to trades, this forming an excellent substitute for the works school.

France.—An "Association Française pour le Développement de l'Enseignement Technique" has been formed to popularize apprenticeship among workmen and employers, to develop methods of teaching and prepare syllabuses and programmes for continuation and works schools. The Association has worked out admirable syllabuses for teaching drawing, calculations and science, facts and principles relating to machine tools and workshop materials. The civic aim is not overlooked. It recommends a final examination for apprentices about to become journeymen, in which a piece of work has to be executed in the presence of a member of the examining committee. This is the same as the system adopted in Switzerland, while in Germany the execution of the work to be placed before the committee may take several months, since it is rather complicated. In any case, the holding of such tests is bound to enhance the status of a journeyman, and to stimulate apprentices to achieve success. No employer in Germany is allowed to engage apprentices unless he has been a master workman for five years, either practising for himself or as a foreman to a firm. Although not compulsory, it is naturally the aim of the apprentice to become a journeyman, and of the latter to become a master workman; since the examinations are imposed by an external authority, the standard can be raised to a very high level. The nearest approach to such examinations in this country are certain trade examinations held by the City and Guilds of London Institute in connection with which a piece of practical work indicating the skill of the craftsman has to be executed, but practically all students who take these examinations have attended for some time at a technical institute.

German Methods in Great Britain.—The phenomenal industrial success Germany has attained has resulted in a very general desire to imitate in England German methods of industrial training. This tendency proceeded so far, in fact, that the preamble to a bill for the provision of compulsory continuation schools specifically mentioned the Munich plan as a basis. It is almost superfluous to point out that German trade schools are the outcome of a long process of development, and that any attempt to enforce a ready-made system of schools in this country is foredoomed to failure, because the temperament and character of the people are so different in England that methods suited to the peculiar genius of the English people must be developed. A few criticisms of Kerschensteiner's method from this point of view may not be out of place.

Although the Munich plan is reported to be wonderfully efficacious in assigning boys to skilled industries, there is little information available regarding the machinery whereby this is accomplished. Before commencing any system of trade education, it is necessary to know the relative proportions of the community engaged in trades, and approximately how many are required per annum to supply wastage. Further, some means must be established whereby those boys most fitted for a given trade are enabled to take it up. It may be—but it is highly improbable—that the German method is to allow a boy to learn the trade he selects. There is no evidence available to indicate whether there has been evolved on the Continent a method of selection which provides for the due needs of the trade and which is satisfactory to boy, parent, and state, but it is certain that some such system will have to be employed in this country, where boys and parents are not so ready to accept official guidance.

Further, although the German trade schools possess many admirable features, it is extremely doubtful whether the ultimate ideal of the trade school envisaged by Kerschensteiner would be acceptable to English people as a whole. It is clear that the type of school advocated by him is one which gives vocational training from the very earliest childhood, and which ultimately prepares boys for the occupations of their fathers. It is only because other difficulties enter into such a scheme as this that it has not yet been realized. The following quotation indicates this position:[1]—

"If we could know very early what vocation a child would follow in accordance with his inclination and ability, if so many children were not dependent upon chance or custom in their choice of a profession, if interest in a special vocation did not develop so late, or never develop, as is often the case now because of the industrial status of the parents or through other causes—if these hindrances were not in the way, then the best organization of our schools would be that in which the children would be grouped according to their future vocation. It would not be right to make these schools merely professional schools, but they could be organized so that the most important part of the school work would be a preparation for their future vocation, and this we have seen is the first duty of the elementary school. Further, if the vocations prepared for by these schools coincided absolutely with the vocations of the parents, then an ideal organization could be realized. This school would not be something foreign and strange to the life of the child. It would not be something isolated from the daily work of the parents. . . ."[2]

Kerschensteiner does not explain how it would be possible to co-ordinate the inclination and ability of the child with the necessity for training him in the vocation of his father, or how far it is possible to reconcile this with other statements in his books, but his intention is clear.

In a country, a characteristic feature of which is the comparatively free rise of all native talent to positions of importance, such an attempt to perpetuate class stratification is bound to fail, however much it may suit the more amenable people in Germany. Trade teaching in Germany, like professional engineering training, has in the past been far too theoretical in its nature, but it is possible

[1] "The Idea of the Industrial School," by Georg Kerschensteiner; translated by R. Pintner.

[2] See for example, "Education for Citizenship," Chap. II.

that attempts have now been made to remedy this defect. It cannot be argued too strongly that Great Britain should develop her own continuation schools on lines which seem most fitting to her people, and any attempt to implant a system which has worked well in a single city in a country completely alien in its institutions and methods is to be gravely deprecated. Some features it may be desirable to incorporate, and the process of choice of the best must be carefully done, and the undesirable features eliminated or modified.

Switzerland.—Switzerland at present possesses no national scheme for apprentice training, although the importance of the matter is fully realized, and great changes are contemplated. In the north-eastern cantons, where the industries are mainly carried on, the state of affairs is comparable with that obtaining in Germany. Employers are compelled to afford opportunities to apprentices for attendance at continuation schools, which are supervised by the municipality and endowed by the canton, state, and employers' federation, and attendance is generally for one-half day per week.

Several large engineering firms, such as Sulzer Brothers, Escher Wiess, etc., have works schools of their own on the lines of those in Germany.

Several schools for the special training of apprentices deserve attention. Youths enter these schools about the age of fifteen, and remain for three or four years, working each day in a training shop, with intervals for class work in drawing, mathematics, mechanics, and properties of materials, occupying about thirty hours weekly. The leaving examination qualifies a youth as a journeyman, and the whole course replaces practical work with a firm. The Winterthur Metallarbeiterschule is an example of schools of this class. A grave defect in them appears to be the wide range of the syllabus, and in many cases boys proceed on leaving either to a technical college or to a works as draughtsmen, etc. The general desire of many boys to get into these schools results in a process of selection of the best from the academic standpoint, which assists this end, thus this type of school fails in its true purpose of producing tradesmen. Machines made by the school are sold to purchasers. The system of allowing one boy to make a piece of work throughout is giving way to the more up-to-date method of placing boys for a period on different machines, so that a deeper knowledge is obtained of each. Teachers of the theoretical work have no connection with the practical work and their teaching follows the stereotyped lines of technical training.

Norway.—Skiensfjordens Mechanical School at Porsgrund is an example of a trades school, providing a three year course for about 160 pupils, and the specific object is to train "workmen, fitters, marine engineers, foremen, factory managers, etc." About one-third of the students intend to proceed to the higher technical schools for further training. Manual work in the workshops is a strong feature of the school, and some of the products are sold. Stress is laid on the better positions gained by its students in after-life, so that the trade instruction may become obscured and develop into work of a technical or semi-technical nature. About 20 per cent of the students appear to remain as workmen.

The Control of Trade Education.—The control of trade schools in Germany is vested in a Ministry of Commerce and Public Works. In England and the United States appeals for some form of continuation education are generally accompanied by the suggestion that it should be put in charge of a special government department or of the Board of Trade,[1] because under the existing

[1] See, for instance, "Problem of the Continuation School," Best and Ogden, p. 73.

Board of Education such schools would not realize their aim. It must be remembered that in Germany there are very few private schools, and that the primary public schools are attended by practically all the children of the community. In fact 95 per cent of the population is educated in the primary schools. This sooner or later necessitates a division between the education of the workers and that of the administrative class, which is all the keener in a country intent on preserving class distinctions. The latter proceed to the high schools, and the former commence work at fourteen, and attend the continuation schools. In the United States a similar condition of affairs obtains, except that the selection of those to receive higher education from those who make up the rank and file is determined by economic rather than social conditions. While primary and higher education is nominally free to all, in practice there are fewer opportunities for the boy of ability to rise from the bottom than exist in England, since any attempt to provide special facilities for these boys in America savours of favouritism and is considered undemocratic. In England, a completely different state of affairs prevails. A large variety of schools for boys and girls exists and will probably continue to exist, and an extensive system of bursaries and scholarships provides an avenue from primary school to university, whereby the higher ranks of professional life receive each year a new influx of the best brains in the nation. On the other hand, few children outside the ranks of the artisan classes attend the primary schools. The aim of every suburban mother is to find the means for sending her children to a private school, the life of which is often much less vigorous than that of the average primary public school, and the tuition in which is seldom so good. Whatever criticisms may be made regarding the aim of

English education, the instruction given in the primary schools, especially the council schools, is remarkably efficient. It is the primary school which provides the great proportion of men for the industries. Out of 155 boys and youths taken at random in the works of the British Westinghouse Co., in the autumn of 1913, no less than 141 came from local council and voluntary schools, six from "higher grade," six from secondary, and two from industrial schools. For these reasons, it seems highly undesirable that a new controlling authority for trade schools should be superimposed on the existing educational system. It would be far better to re-organize the existing Board of Education so that it could control a set of trade schools effectively, or to *replace* it, rather than supplement it, by a new authority which could give point to existing primary education and leave the Board free to control higher education. An extra authority means duplication of machinery and expense, while the gap between the primary school and the trade school would be as wide as ever. A single authority would be able to modify the final years of the primary school so that a definite skilled trade could be followed in after years without all the existing waste.

The important point in the administration of German trade schools which could be copied with advantage, is the power delegated to a local authority to decide on the character of the trade instruction. The tendency industries have to concentrate in one centre, and the presence of industrial experts in the locality make it very necessary that this should be the case.

CHAPTER X.

APPRENTICESHIP.

IN mediæval times, craftsmen were trained during a long preparatory period through a system of apprenticeship, and a very close association existed between masters and apprentices. A legal contract defined the rights and obligations of both parties, the apprentice agreeing to remain till he attained his twenty-first year (the English legal majority), or for a prearranged period, usually seven years, and to be diligent in his work; the employer, on the other hand, practically placing himself *in loco parentis* to the boy and contracting to teach him all the mysteries of the craft. An industrious apprentice often acquired an important position in his master's establishment, and not infrequently succeeded him in business. At that time the training was mainly one of development of manual skill, and embodied experience with the materials used, gained by working on them, and by the acquisition of experience and knowledge handed down—often jealously guarded—by older craftsmen. Scientific knowledge applicable to industry was extremely limited.

Modern economic conditions have resulted in the formation of limited liability concerns of huge magnitude, employing very large numbers of workers. No longer does a master, or in fact any single individual, stand in the old relationship to the apprentice, and nothing in the modern industrial world replaces that relationship between him and his employer. In this sense there is undoubtedly a great loss to the apprentice, and it is the restoration of this state of affairs that many people have in mind when they plead for the re-establishment of the apprentice conditions of a previous age. That industrial conditions have entirely changed, that old-time apprenticeship is utterly unsuited to modern requirements, that it is necessary to appreciate modern industrial needs and then adjust industrial training to suit, are points invariably overlooked by them; modern conditions do not permit of a revival, even if it were desirable. What is required is an examination of the new conditions, and the introduction of special methods of training to suit them. Mediæval apprenticeship depended for its success on the goodwill existing between the contracting parties, the personal relation dominating all others, which nowadays does not obtain to the same extent. Following upon the introduction of machinery came a great influx of the increasing population to share in the work of production. The mere increase in numbers was sufficient to render older conditions difficult to apply, because of the possibilities of greater numbers of both apprentices and unreasonable employers,[1] the acts of whom were bound to affect the conditions for the whole industrial body in competition for the same markets. Thus it is that to-day no contract at all is preferable to the legal indenture in many industries. A verbal agreement between an employer and a youth that the latter shall come to a works and learn a trade while in receipt of a definite wage is beneficial in stimulating an apprentice continually to satisfy an employer by good work, which is obviously good for the apprentice himself, since if he is unsatisfactory he can be discharged. On the other hand, an employer will

[1] Dr. Shadwell in his "Industrial Efficiency" considers that the evils of the present industrial system which can be traced to employers, are due to thrifty workmen who have become employers rather than to capitalists.

always endeavour to keep a good apprentice, and will invariably afford him facilities for obtaining a good trade knowledge since he has the option of leaving at any time if conditions become less tolerable than those obtaining elsewhere.

Technical and Trade Apprenticeship.—It is usual in a modern engineering works to provide practical training for those intending to enter technical employment as well as apprentice courses for artisans. Considering the general division of workers outlined in Chapter I into technical and manual workers, and the difference in function between them, it is evident that their educational needs are widely different, this difference being brought about by the widespread application of science in every branch of industry. The division is becoming more distinct as the discoveries of science applicable to industry daily increase. The technical man must of necessity possess a scientific education, and his training is incomplete without practical experience. The function of the latter, however, is not to make him a skilled workman, but to afford a general knowledge of works routine and works processes. There is much controversy in the engineering profession whether this should precede or follow a college course. Among the general public the distinction between the two grades of apprenticeship is not sufficiently realized. Some firms make no distinction between the courses for trade and technical apprentices, but up-to-date works provide courses appropriate to the needs of each, and the technical apprentices ultimately join the staff of the organization while the trades apprentices become the skilled workmen. For a graduate in engineering, two years practical work is considered sufficient by the British Westinghouse Company, while for other technical men there are three year courses. The trades courses, on the other hand, last from five to seven years.

It is not the purpose here to discuss further the branch of apprenticeship training which provides professional engineers,[1] but merely to call attention to the fact that it represents a marked difference from the trades apprenticeship. It is extremely desirable wherever technical and trades courses are provided, that trades apprentices should, if they possess sufficient ability, be able to reach technical employment. If they obtain sufficient technical knowledge, their practical experience is very useful in subsequent work.

Trade Apprenticeship.—To carry out any systematic course of training necessitates keeping a youth in the same works for a considerable period of time. In Great Britain it has been usual for boys to enter a works after leaving school, i.e. between the ages of fourteen and sixteen, for an apprenticeship which terminates at the age of twenty-one. In America, and to a considerable extent on the Continent, a four year period is common. The legal indenture has in recent times been abandoned in favour of a formal agreement which imposes a moral but no legal obligation on both parties to carry out the same conditions. The employer retains the right to discharge the youth for bad conduct, but it is understood that this is only resorted to in extreme cases. On the other hand, the youth may leave if he is dissatisfied with the conditions, so that employers can no longer exploit boy labour with impunity. In some firms even the agreement is lacking, and it is tacitly understood that a boy who pursues practical work in an engineering concern for the period of time usually undertaken by an apprentice, is qualifying himself for the status of a skilled workman, and as such is accepted by his Union.

Some firms require a premium, usually of a few

[1] For further details see "Training for the Industrial Side of Engineering," by A. P. M. Fleming, Proc. I.E.E., No. 246, Vol. 53.

pounds, as a guarantee against damage and loss of tools, and this may be repaid at the termination of apprenticeship. In almost all cases, a small progressively increasing wage is paid during part or the whole of the apprentice period, which may be augmented in some cases by a piece-work or bonus system. The plan prevalent a few years ago of employing premium apprentices is now happily dying out, except in certain of the large railway and other works. Under this plan, youths of well-to-do parents were employed in works on payment of a heavy premium, and admitted to a course of practical training, with a view to preparing them for posts of responsibility. Unfortunately such apprentices were not selected because of their ability, but rather on account of their financial resources, and hence they did not make necessarily the best material for future industrial officers. In progressive modern works this system is obsolete. Apart from the recognized form of trades apprenticeship it is common in the engineering trades for some youths to migrate from one works to another, in search of new experience. This method, while possessing some advantages, is on the whole very unsatisfactory, both to the youth and to the industry. From the point of view of the latter it represents an unstable factor in labour, and as regards the youth, the migratory tendency developed in this way is likely to persist in after-life. He is not always certain of obtaining new experience that is really valuable; moreover, he loses the value of the personal connection with the staff which should exist in works having a well-defined apprenticeship system.

Modern Conditions.—In general, apprenticeship conditions in Great Britain are chaotic. Except in a few cases, no definite plan of training exists. The youth is conscious of no well-defined aim, and lacks keenness and enthusiasm, without which his capacity for absorbing experience and knowledge is tremendously diminished. There is no definite standard regarding what constitutes a skilled workman or craftsman. Many works employ so-called apprentices, whether the latter can be taught anything or not. Even where apprentice agreements are drawn up, too often youths are exploited on repetition work, and no heed is given to the obligations due to the youth or to the community, the welfare of which is bound up in a measure with that of the body of skilled workers. Often this attitude is due to sheer ignorance of the importance of training apprentices on the future of our industries. In large concerns, it is possible to employ considerable numbers of youths, so that it becomes increasingly difficult to supervise and instruct them individually. Foremen are usually too much burdened with routine duties to give much attention to apprentices, workmen are often engaged on piecework and are disinclined to teach them anything, either because of the working time thus lost, or because of a desire to keep their craft knowledge to themselves. In a few works supervisors of apprentices are employed, and while this plan has excellent features where a single trade has to be taught in works of only moderate size, it is likely to prove unsatisfactory in big organizations where many supervisors would be required. There is often a conflict of interests between foremen and supervisors, the former requiring large output of work, and the latter a high quality. The lack of a definite plan of training is responsible for a great decline in apprenticeship of any kind, because in many works the shop youth who is not "bound" is able not only to earn more money, but has all the privileges of a formally apprenticed youth, so far as either have any at all. Such a system is, of course, fatal to the success of a sound apprenticeship system, since the most promising boys are unlikely to commit themselves to a long period of service at small wages without any special ultimate advantage to themselves. Quite apart from the general lack of sound practical training, employers fail to realize the need for suitable instruction to accompany works training, and in a vague way conceive that evening technical instruction provides this, a conception which, as already shown, is quite erroneous.

It has been customary by some to consider that apprentices are much better trained for their craft in the small trade workshops than in the large ones, because the former are equipped with the less up-to-date machinery, and thus offer more scope for manual skill. There is no doubt, however, that a large works offers exceptional opportunities to apprentices if there is an organized scheme in operation for training them, because of the wide range of product dealt with, while the small shop tends to restrict itself to a single line. In the case of technical apprentices this is an especial advantage. Further, if the progress of industry in the future is towards the increased use of machinery the value of manipulative skill in at least some apprentices may be decreased, and an increased stress laid on an intelligent knowledge of workshop machines. In this case the large works scores heavily owing to its more modern equipment. Further, it is important that such works should train their future workmen not only because of the methods peculiar to the works, but because it is necessary to establish a connection between the workers and the staff.

The present nondescript and chaotic character of apprenticeship requires remodelling and placing on a new footing. It appears unlikely that much progress can be made in this direction before employers are compelled by statute to provide well-defined means of training, and—to ensure that apprentices are brought to a definite standard—to send their apprentices to be tested by examination before a tribunal of trade experts. It would add much to the status of certain trades if the continental plan were adopted of holding a definite examination for apprentices in a given trade before they could practise as journeymen, and a further test before they could become master-workmen, starting in business for themselves, and employing apprentices.

Trades Unionism and Industrial Education.—There appears to be no clearly defined policy on the part of trade unionists regarding industrial training. Speaking broadly, there has been in the past a suspicion, which has not been without foundation, that apprenticeship had degenerated to a device for securing cheap labour. In consequence, a feeling of self-protection led the unions to set up restrictions on the number of apprentices, to prevent the trade being flooded with numbers of partially skilled men without adequate training and of low earning capacity, but as a policy this has broken down. If a feeling of confidence in the value of apprenticeship as a factor in proper training could be restored the unions could do much towards making such training effective. Their members comprise many of the most highly skilled workers in the country, and the attitude they take up undoubtedly influences the younger men in the shops to a considerable extent. With their expert knowledge, co-operation between the unions and employers would do much towards the fixing of a definite standard of trade education and the raising of the standard of workmanship. In this matter the unions have an excellent opportunity of formulating a broad progressive national policy rather than a more restricted one dealing only with the interests of a special group of workers. Interest in such a scheme could be aroused, especially among the employers and workpeople concerned, by the use of the technical, trade, and daily press, which should systematically devote space to the record of forward movements in industrial training and to the interchange of experience gained in promulgating it; by the formation of an association of individuals or firms interested in industrial education, such as those which exist in the States; by legislation tending to raise the status of apprenticeship and a trade and to guarantee the efficiency of training found at certain places; by canvassing of employers by industrial experts; by illustrated lectures on vocational subjects in schools and elsewhere which will assist parents and scholars in realizing what work certain trades involve.

CHAPTER XI.

THE REAL PROBLEM OF INDUSTRIAL TRAINING.

It has already been noted that the old-fashioned plan of apprenticeship does not satisfy modern industrial needs. Formerly, the distinction between non-skilled and skilled workers was clearly drawn, and the requirements of each trade were met by a training which developed purely manipulative skill. In each trade the range of utility of the product was limited, and introduced little of a novel character; competition was not acute, and did not necessitate such close attention to time and labour-saving appliances. Repetition work was more or less unknown. The delicate and intricate nature of much of the work that had to be performed by hand involved a long period of preparation, and the uniformity and small number of the materials employed enabled a working knowledge of them to be gained during this period merely by the everyday contact. To-day the scope of each trade has been extended enormously, and involves the use of many different materials of several grades, an ever-increasing variety of tools and appliances, and a widening scope and variety of uses for the products. Due to the growth of industry and keen competition, new methods and new applications of science are evolved, of all of which advantage must be taken if success is to be achieved. While the necessity for a high degree of manual skill in some trades is as exacting as ever, in others the employment of tools of precision imposes less need for it on the workers. On the other hand, there is need for a much wider knowledge of the scientific foundation of the processes, of the materials, and of the function of the finished product, so that although the training required is no less exacting, it is of a somewhat different character. Many workers cannot hope to obtain practical experience of every phase of work with which they may be confronted, but the knowledge of the fundamentals of the craft will equip them to undertake any task which changing conditions may demand. The whole problem is complicated by the fact that the introduction of machinery and consequent cheapening of the product, resulting in increased production, has rendered it possible to utilize the services of large numbers of people inferior both in intelligence and experience to the type of man who makes a first-class workman. Manufacture in bulk and new methods of remunerating workers, in addition to specialization and repetition work, are other factors having no counterpart in old-time conditions.

All these conditions, combined with a tendency to shorten the apprentice period, render it essential for a worker to acquire experience in other directions, as well as that obtained from manual work. He must be able to assimilate the experience of others who have laboured at the same trade. He must be able to recognize the underlying features and principles it embodies as it is carried on by other workers, possibly in other countries, under different conditions.

Nature of Apprentice Training.—Complete apprentice training has thus a dual character. It comprises, on the one hand, the development of manipulative skill, which is ordinarily termed practical experience, and a complementary portion represented by the acquisition of knowledge and experience of the materials and tools of the trade, the imparting of which constitutes trade education. Training will be most efficient when these two phases are most closely co-ordinated, and when they proceed hand in hand. The ideal foundation for this instruction is formed by the provision of primary education of a character which enables boys to assimilate the scientific principles involved in their trades, preferably on lines already suggested in Chapter V, and then, after the youth has been carefully guided to that trade by his natural aptitude and inclination, to provide means whereby he is able to acquire the necessary practical experience, i.e. manipulative skill. Concurrently with the acquisition of this, an expert who had an intimate knowledge of the trade concerned would teach him all the knowledge necessary to a thorough understanding of the trade which he would not otherwise acquire, except in an unsystematic and haphazard manner, in individual working. Although to secure maximum value these two phases must be closely correlated, it will be shown later that they have to be taken separately. The solution to the problem of the best methods of undertaking such training can best be determined by an analysis of each portion, followed by a consideration of how these can most satisfactorily be treated.

Manipulative Skill.—This is, of course, not taught in the usual sense of the term, but is obtained by constant experience and long practice, and comprises four more or less distinct stages, as follows :—

(*a*) Entering works straight from school, it takes a boy some time to become accustomed to his new surroundings and to adapt himself to a new environment, so far beyond the range of his previous experience. In this stage he commences to recognize the commoner shop machines and tools, to learn trade terms, and generally to become accustomed to workshop conditions.

The duration of this stage depends upon the degree of the adaptability of the boy, and as at this period he is generally eager to learn, it should not last more than a few months.

During this period, and in fact often throughout the entire apprenticeship, a boy may be employed a great deal in running errands, or in a low grade of labour having little or no connection with his trade. While to some extent this may be justified in the early stages of apprenticeship, especially in large works, since it assists the apprentice in a knowledge of his surroundings, it is often carried to excess, and from all points of view is detrimental to the interests both of the employer and the apprentice. Further, since this stage is usually a probationary one, the capacity of the apprentice cannot satisfactorily be judged unless he is given some of the operations of his trade to perform, and moreover, without such experience, the instinct which prompted the boy to enter industry is likely to be thwarted, and by an unsatisfactory probation promising material may be rejected from the industry.

(*b*) In the next stage the apprentice obtains practice with the tools and materials of the trade, and in time attains a degree of accuracy of workmanship necessary for the trade requirements. This period may extend throughout the whole time of apprenticeship, depending upon the natural characteristics of the apprentice, and on the complexity of the trade processes.

In most trades, while the attainment of proficiency with a few tools may be sufficient to establish the required sense of technical accuracy, it is desirable to obtain experience with as wide a range of tools, appliances, and materials as possible in connection with all the work covered by the trade. In this stage, however, the important requirement is thoroughness and mechanical accuracy.

(*c*) Having acquired the requisite degree of accuracy and soundness of workmanship, it is now necessary to develop speed of working so as to obtain the maximum amount of productive output. This speed increases as some fundamental operations become automatic and habitual, leaving the mind free to consider more important matters on which the progress of the work depends. For example, in machining operations a careful workman will think ahead, and during the machining of one piece will have arranged for the delivery of the next job, will requisition his tools and drawings or fixtures, and in this way reduce the time of stopping his machine for changing jobs to a minimum. This stage of apprenticeship is the most important of the four. It occupies the longest time, and in some trades it is never completed but develops with the widening experience of the worker during the greater part of his life.

A consideration of the importance of this stage will show how impracticable it is to attempt to teach a trade other than in the works under commercial conditions.

(*d*) The fourth stage comprises a period which should be devoted to broadening the apprentice's experience by giving him work on a wider range of machine tools or processes. The sense of mechanical accuracy obtained by prolonged experience with a limited range of tools or processes in the second stage becomes readily adaptable to this wider scope. This period may, where the local conditions permit, include experience in a closely related trade. For example, pattern-makers should obtain some moulding experience, and fitters would be better workmen if they did some turning work.

It must be remembered that the last three stages are very much interlinked with each other; for example, the acquisition of mechanical accuracy and productive output to some extent develop together, also an apprentice may be enabled to acquire the wider experience of the fourth stage much earlier in his course, depending on the local conditions. It is important to note, however, that these stages are all necessary to a worker's training.

How it can be Acquired.—From the consideration of the four stages through which a youth passes in acquiring manipulative skill, and especially noting the importance of the second, third, and fourth stages, it will be evident that the only satisfactory means of dealing with this phase of the problem is in the works.

Realizing the importance of manipulative skill, a number of companies have concentrated their attention solely on this phase of training, and have established training shops attached to their works where the apprentices receive attention from a competent instructor before entering the works proper. In one case the whole of the training period is spent in this shop.

The advantages and disadvantages of the special training shop may be stated as follows :—[1]

Advantages.—(*a*) It permits a more accurate comparison of the eagerness and intelligence of each boy than the main shop, because it partakes more of the character of school work.

(*b*) All work is done under the same supervision, hence there is greater regularity and uniformity of training.

(*c*) Theoretical instruction is readily co-ordinated with the practical work.

Disadvantages.—(*a*) The apprentice is slow to feel responsibility for satisfactory work.

(*b*) He also fails readily to get the correct idea of his place as a workman in a factory, and the necessity for co-operation with other workmen.

[1] See a paper by Dr. Brant at Coblenz, 1911, printed in the "Abhandlungen über technisches Schulwesen" (Deutschen Ausschusz für technisches Schulwesen).

(*c*) Direct inducement to turn out good work is missing, and no relation exists between work and wages.

(*d*) Organizations carrying on several trades require either a special trade equipment and workshop for each, which is very expensive, or a limited instruction of all apprentices in one shop, which then ceases to be trade instruction proper.

(*e*) Shop discipline is lacking.

(*f*) There is a tendency to place on the training shops, where they exist, responsibility for complete apprentice training which can only be undertaken satisfactorily by the works as a whole. In such cases the apprentice when in the works is looked upon too much as a productive unit, rather than as a learner in training.

The training shop, therefore, by no means solves the difficulty of industrial training, even so far as gaining manipulative skill is concerned. On the other hand, while the main shops may successfully overcome all these difficulties, they do present great disadvantages of their own, because it is difficult to obtain time for careful training, and individual treatment cannot be guaranteed. Thus there is lack of uniformity in training, and ignorance of the capacity of each apprentice.

A workable compromise, so far as the second stage of training is concerned, is to segregate a number of apprentices in each shop or department, and place them on a special bench or group of machines under the control of an instructor or a senior apprentice, who would be responsible for training the younger apprentices; seniors in this manner may be trained for higher positions as charge-hands or foremen. The apprentices so segregated would be interchanged with those working under normal conditions when they had acquired sufficient skill. Thus apprentices would get the advantages of specific instruction alternating with the advantage of working with ordinary tradesmen in the usual way.

In many works, whether large or small, where for any reason it is not practicable to adopt this means of insuring suitable practical training, the same end may be accomplished by employing foremen and charge-hands who have not only a desire, but a capacity for instructing the youths under their control, and who appreciate the importance of doing so. Even a few suitable foremen in a large works will set a standard which others may be induced to attempt to attain. It must be feared that most foremen, however, are not of the type of men who make good instructors, being compelled to think far more about production than apprentice training, which leads them to utilize apprentice labour in a short-sighted way. Many such men are inclined to be doubtful about new methods, and often adhere to conditions which obtained when they were learning the trade.

Many technical schools have been fitted in recent years with elaborate equipment for workshop practice, although no student works in the shops for more than about two hours each week. It is clear that an apprentice who is in a factory for fifty-two hours weekly for six or seven years, is in such a position to acquire skill that the superposition of another course in an evening technical school for a few hours weekly during a period of a few years, will not afford any appreciable advantage, unless he is able to use special machinery or to obtain experience on higher class work than commercial practice affords.

The Nature of Trade Instruction.—It is popularly held that the process of acquiring manipulative skill is the only requirement in learning a trade, and the adherence to this belief tends to produce a highly conservative type of workman who views innovations with much distrust.

Trade knowledge, such as that possessed by all-round, adaptable workmen, consists in the principles underlying the various processes adopted in the trade; the names, descriptions, uses and construction of tools and appliances used; the method of reading drawings and diagrams, the origin, properties, and uses of the various materials selected; elementary ideas on the cost of the product; the importance of avoiding waste of material, time, and of effort; the functions of the apparatus and the parts thereof which he assists to manufacture.

The value of this portion lies largely in the fact that it makes a trade a rational conception to an apprentice. He is able to relate cause and effect, to attempt to provide new methods instead of conserving old, to appreciate the value of new and improved processes and to understand them quickly, and this knowledge should enlighten every difficulty met with in acquiring manipulative skill.

The instruction provided must link up the trade requirements with the education the youth has received at the primary school. The lines on which it will work are settled partially in the early stages by the average mental level of the average elementary schoolboy, and the point of view taken by the elementary school teacher.

It is customary for the average boy to leave school with certain ability to use figures and words, without in many cases having a practical conception of what the figures would mean in terms of things, or what the words actually relate to in practice. It is necessary, therefore, to take up the thread of primary school instruction where it left off but from an entirely different aspect. Thus the juniors might revise decimal and vulgar fractions and mensuration of simple areas and volumes, but with many references to practice and concrete examples. These three sections of arithmetic cover nearly all that is required for works apprentices in engineering trades, and nearly the whole time should be spent in working examples.

Further instruction should consist in explanations of common everyday phenomena, and in making the acquaintance of certain materials which are in common use in the workshop, leading up to what might be called general workshop knowledge and simple engineering facts such as any man who has to work with his hands may reasonably be expected to know. Crowning this instruction should be actual lectures by trade experts, given to apprentices of their own trades, in which the accumulated experience of a lifetime is crystallized and made useful to the juniors. Classes for budding draughtsmen, salesmen, accountants, technical correspondents, testers, etc., will also be required provided numbers are sufficient and if any scheme of promotion for apprentices is adopted. As the point of view of the primary school changes, the earlier lectures may be dropped, but the trade lectures will always be required, and under a system of primary education such as is outlined in Chapter V, the scheme would be arranged so that there would be two or three classes for each trade, and the preliminary work of each carefully thought out so as to lead up to the purely trade work.

This instruction, as already stated, must proceed hand in hand with daily shop experience. Taking, for instance, the work of a man who is learning "turning". In the shop he will become acquainted with the appearance of the lathe in its various forms, of other shop tools and machines, and will have an opportunity of learning how to set work up, how to cut and lubricate it, and how to test it. Increasing skill will make him increasingly facile in turning out good work, and finally, although he can learn most of his trade on a lathe of the simplest description, he will get opportunities of using other varieties of lathes and machines, with possibly some experience in fitting parts together. Concurrently with this, his work in the schoolroom would proceed on lines somewhat as follows. In the early stages he would study vulgar and decimal fractions and the mensuration of simple figures, with practical applications to turning, such as the reading of the micrometer gauge—which demands the necessary knowledge of decimals—will consider the question of ratio, and be able to construct for himself the trains of wheels for screw-cutting purposes. In mechanics he would deal with the simple machines, mechanical elements and their shop applications in levers, pulleys, screws, jacks, and blocks.

He may, without necessarily understanding the theory, learn to use logarithms and the slide rule, and will learn to calculate his wages on any basis which the firm may use. Subsequently, the methods of transmitting power by belts and gearing would be dealt with, together with such phenomena as occur in his experience affecting his work, like expansion and contraction due to heat and cold. In view of the application of electric drive in the workshops, he would acquire simple notions about the electric circuit. He would be taught some facts about the nature and prices of the materials and the tools he uses, and why they are used. In the final school period, he would pay attention to such important trade matters as different methods of gauging, centering, the whole question of "feeds and speeds," and the effects of changes in these on the machine, the work, and the tool. The importance of economy in time, material, and effort would be urged throughout, and opportunities of showing him other processes in the school and the works would be taken.

Thus as a workman he would stand an independent unit, able to work on any job with which he is confronted without supervision, working economically because he knows exactly what he is doing, and at the same time capable of full industrial capacity in his special line of work. There is little need for an absolutely all-round craftsman, such, for instance, as the old-fashioned mill-wright. His experience was such that, due to his wide practice in all kinds of jobs, he could do everything moderately well, but not necessarily quickly. Give a man sufficient trade knowledge so that he understands why things are done, and this will to a large extent take the place of the wide practical rule-of-thumb experience, and enable him to carry on his more limited work at full productive rate, and at the same time be able, when necessity demands, to carry out the wider scope tolerably well, although his practical experience in it may be limited. At the present time there is no general provision for trade instruction which proceeds hand in hand with the apprentice's daily work.

It is extremely difficult to decide at first exactly what instruction an apprentice needs, and how far it must differ from technical instruction, but reference to the difference in function between the craftsman and the technical worker outlined in Chapter I, together with the general nature of trade instruction given on p. 133, will settle the point to some extent. One very broad distinction between technical and trade instruction is found in the fact, that while the technical worker's training is almost entirely mathematical, that of the tradesman should be non-mathematical. While he should, for instance, be facile in manipulating simple figures, vulgar and decimal fractions, and ratios, the applied mathematical side of the scientific foundation of his trade does not concern him. For instance, while it is essential for a steam-engine designer to know quantitatively how the horse-power of a cylinder is dependent on linear dimensions, valve settings, condition of steam, etc., a steam-engine fitter only requires to know the general method of working of the engine, without any mathematical details, even of the simplest kind. Yet it is not too much to say that at evening technical schools, classes for artisan students are required to consider the calculation of the horse-power even before they are acquainted with the method of working and running a simple engine. Experience leads them to associate a definite size of cylinder with a definite output for normal running conditions, and this is perhaps as much as the average artisan requires in this direction. Similarly, an apprentice engaged on the erection of electrical transformers does not need any of the mathematics of alternating currents so essential to the designer, but it is desirable that he should have some idea of the effects of an electric current and the functions of the transformer itself, and how to remedy any trouble found on operation. He will not require any of the factors which influence design, but will from experience soon associate a given size of transformer with a definite output. The advantages of apprenticeship combined with some form of training such as is outlined in this book may be summarized thus:—

(*a*) Great saving of time is due to the fact that apprentices learn to perform trade processes methodically and in an understanding manner. Owing to the existence of an active interest in work less time is wasted. Time is further economized owing to the greater independence of each workman, who may be practically a self-directive unit, and less assistance is required from supervisors and others. Apprentices mature much more rapidly than those who have no specific direction, and the length of apprenticeship may in consequence be reduced.

(*b*) Inculcation in the apprentice school of the principles of economy, together with a knowledge of the value of materials used, leads to greater carefulness in the use of shop materials, especially in those processes where the quantities employed depend upon the discretion of the worker. Also owing to greater skill in handicraft there is less likelihood of materials being spoiled by defective workmanship.

(*c*) A proper comprehension of the elementary laws of mechanics will assist a worker in appreciating the best way in which effort may be applied, and the expenditure of effort to do what may be impossible under given conditions is avoided.

(*d*) Apart from the cumulative saving in money which other advantages represent, there is a direct saving due to the more intelligent handling of machine and other tools. The carefully trained workman has a greater appreciation of the need for co-operation and can assist considerably in the synchronism of operations which are necessary to prevent congestion in the shops and consequent handicap to production. The body of employees will possess greater resource, and consequently less supervision by inspectors, foremen, and charge hands will be required. They will be able rapidly to acquire facility in work other than that which they have done previously, and thus enable the company to work with a smaller number, owing to superior flexibility. Workers will become fixed and will not migrate so much from one concern to another. Each worker will involve a smaller proportion of general expenses—rent, rates, etc.—owing to his greater efficiency. The community will save wasteful expenditure on unsuitable methods of training.

(*e*) A good feeling is created between employers and employed and mutual confidence established tending to a just return to the worker for his productive effort.

(*f*) The necessity for care in using machinery, electric current, etc., can be better emphasized and appreciated.

(*g*) The development of accuracy, self-reliance, self-respect, independence, and love of work which are found in many skilled workmen make an excellent basis for training for citizenship.

(*h*) A scheme of training which makes provision for proper choice of work by a boy will enable him to accommodate himself to the work for which he is best adapted.

(*j*) The introduction of a system of education which will command the confidence of parents and scholars will make for success.

(*k*) The economic loss of many boys in "blind-alley" employment can be prevented.

CHAPTER XII.

A MODERN EXAMPLE OF APPRENTICE TRAINING.

IN view of the important place that works schools are likely to occupy in industrial education, a description of the inception, development, and progress of one such school may be of interest, and possibly serve as a guide to those firms contemplating such means of instruction for their apprentices.

The British Westinghouse Company, up to the autumn of 1913, had practically the same conditions of labour and apprenticeship as most other English firms. It was recognized that under modern conditions it is not possible for an apprentice to acquire the requisite knowledge of his trade solely from his shop experience; also that the normal instruction of the technical schools is of comparatively little value to the workman who would remain permanently as such. It was therefore decided to provide suitable instruction on the premises during works hours.

While there were a large number of boys in the shops, the number who had signed the apprentice agreement form was exceedingly small, and the quality of many of these was poor. It would seem that the system generally attracted a poor type of youth, who was anxious to possess the security that a period of apprenticeship would give, while the most intelligent youths moved about from shop to shop, and trusted to their experience to enable them to acquire a steadily progessive rate of wages and standard of work. It was necessary to work against all the inertia of an existing system and all the suspicion associated with an innovation, and in no sense could the conditions be said to be more favourable than would ordinarily obtain in engineering works.

In January, 1914, about three hundred boys in the works, the age and general condition of whom seemed to make some instruction desirable, were interviewed. They were subsequently examined and arranged in order of merit. The upper hundred were discarded for the time being, as being well able to look after their own further education through evening schools and private study. In order that the experiment should not be prejudiced by the introduction of poor material, the lower hundred were rejected for consideration at a subsequent date and the middle hundred chosen for purposes of instruction. About 25 per cent only of the selected boys were "bound" apprentices. Owing to the wide difference in age and the extremely diverse nature of their attainments and previous education, it was extremely difficult to grade these boys into any semblance of order, so that at first the same instruction was given to all. One hour on each of four mornings per week was devoted to different subjects, with one hour for a test on the week's work on the fifth day with one half of the number chosen. In a second hour a second group of fifty was dealt with in the same way. The subjects given were mathematics, mechanics, drawing, properties of materials. Subsequently, as the best apprentices in each group began to separate out, a series of special trade lectures was prepared, addressed by foremen and experts in their particular lines. Three classes of grouped trades were formed, the first dealing with the mechanical trades, such as fitting, turning, toolmaking, and machining generally; the second with the electrical trades, electrical assembling, coil and armature winding, etc.; and the third with the iron and brass moulders, core-makers, and pattern-makers.

These classes were at first held once fortnightly, and later each alternate week was occupied with a tutorial lecture on the same subject by an engineer. To these classes the most promising of the first two groups were admitted, as well as older shop apprentices who had not previously received any instruction.

It was tentatively decided that each session should last six months, and after a temporary cessation for a few weeks caused by the outbreak of war the school was recommenced in September, 1914. Since it was obviously impossible to commence any period of training which might be interrupted by a youth leaving the firm, instruction was now confined to those youths of sixteen years of age or over who agreed to remain in the company's employ until they were twenty-one years of age, i.e. who were prepared to become apprentices. In consequence of this, a steady improvement of quality and a decided increase in number of apprentices has set in, so that a mere handful of apprentices became (in February, 1916) over 300, despite the fact that about 130 of the older apprentices have joined the forces.

The system of instruction was then organized into three classes.

Class A received instruction for five hours weekly; one hour being devoted to each of the following subjects: Practical arithmetic, mechanics, elementary science, general instruction, and one hour for examination.

Class B was likewise treated, except that the "general" course was abandoned, and properties of materials succeeded the science course. Each subject was, of course, more advanced than in the lower class.

Class C remained as before, a specific trade class, receiving lessons from experts on trade technique and problems, By the end of this session the scheme began to work more smoothly, and in the following session further developments followed.

The plan of training now attracted attention, and numerous applications for apprenticeship were being received, many from boys who were only just over fourteen. A new class was commenced for these youths, a nursery which would hold them until they could take advantage of the higher classes. It was rapidly discovered that these youths, owing to their superior quality and freshness, having only recently left school, were practically equal to the class above them in general level of attainment.

At the same time a class was introduced between "B" and "C" as a further extension of the trade instruction, but dealing collectively with all apprentices in the different trades, it being felt that, in view of the fact that conditions do not favour the interchange of apprentices in various shops dealing with different trades, such instruction as it is necessary to give one apprentice in the operations of trades other than his own may be best given in school, combined with visits to the shops. These two new classes were known as 1 and 4, and the remaining three changed to 2, 3, and 5.

The primary object of the school is to assist the production of skilled workmen, but a secondary object is the determination of those apprentices who are fitted by natural capacity for more responsible work. In a number of cases it was found possible to provide an outlet for such men in the various testing departments, work which demands, in addition to a general shop training, considerable technical knowledge. For these men special testers classes were arranged, and the methods of testing employed by the company with their theoretical bases demonstrated.

Further, it was considered that engineering draughtsmen require a considerable preliminary period of shop training, so that they may know adequately the actual materials and their forms as used in the shop, and obtain a practical concrete knowledge of each piece of work and the limitations introduced by shop conditions. In some cases previously, boys had been prepared for work in the drawing offices by copying drawings, tracing, etc., and had thus acquired an academic knowledge of draughting, but lacked shop knowledge. The more farseeing of these youths attempted to make good the deficiency by going to the shop for a short period of six months or so. Since this period was insufficient, the policy of apprenticing "draughtsmen" was abandoned, and all junior positions in the drawing offices are now filled from among trade apprentices who have followed a trade for a suitable period of time and who evinced ability for the new work. This method has proved quite successful, and has been made permanent. Thus the drawing office is a natural avenue for promotion for trade apprentices, and acts as a stimulus to those desiring this work. A drawing office class has been provided for these apprentices. This class was in the second session confined to those apprentices from the shops who had shown special aptitude and to whom a knowledge of the principles of machine drawing would be of value. Some of them will be promoted later to the drawing office, others will use their knowledge in the shop. It is rather curious to note that either because of the enhanced status supposed to be attached to draughting, or because it is cleaner, many boys desire to do this work. Many, however, alter their opinion when they have tried it for a period, and prefer the active life of the shops.

In addition, it has been possible to place several apprentices having commercial aptitude who have nearly completed their time in the sales organization of the company, where their long experience of the firm's products and methods can be turned to advantage, either in the home or branch offices. Whatever training it demands —technical, commercial, or trade—there will shortly be no post in the company's service to which a trade apprentice cannot rise, provided he has the necessary perseverance and ability.

In order to assist the best of these apprentices to acquire technical training, the company sends ten of them to the apprentice day course at the Municipal School of Technology, Manchester, where they attend, one day weekly for two years, all expenses for books and fees being borne by the company, and wages are paid during the school period. There is keen competition for these scholarships, and without exception the holders show promise of achieving higher positions than those usually open to workmen. About twenty men are always in training in this way.

In the new session which commenced in August, 1915, little alteration in the general arrangements was made, except that the syllabuses were re-cast and the whole scheme crystallized into definite shape. The hour devoted weekly in each class to a test in the preliminary classes was abandoned, this having served the very useful purpose of finding out what had been given to the boys and how much of it was absorbed—a very necessary precaution with a staff of teachers who, almost without exception, were amateurs.

This change enabled the time hitherto taken to be cut down to three hours per week in the first three classes, and one and a half hours per week for 4 and 5, a minimum due to the exigencies of war production. Class 4 was split up into two, 4a, mechanical trades apprentices, and 4b, electrical trades apprentices, and it is intended that this class shall ultimately be divided into trades just as class No. 5, and form a junior trade class. In class No. 5 provision was made for a special group of apprentices in the Transformer Department to receive instruction in transformer erecting, including coil winding, insulation, and erection of transformers. The moulders and pattern-makers were separated into different classes, and the necessary connection between their trades is shown by appropriate lectures in each course. The "machinists" group will next be split up into machinists and turners on the one hand, and fitters on the other. It is intended to strengthen the trade element as men are trained to take the classes, and as the elementary schools make it less necessary to revise and recapitulate the work they are supposed to accomplish. In February, 1916, a new class 3b was rendered necessary.

The arrangement of classes at present is as follows:—

Class 1 . .	3 hours weekly	Arithmetic.
		Drawing.
		General.
Class 2a and 2b each	,, ,, ,,	Mathematics.
		Mechanics.
		Elementary Science.
Class 3a and 3b ,,	,, ,, ,,	Mathematics.
		Mechanics.
		Properties of Materials.
Class 4a . .	1½ ,, ,,	Mechanical Apprentices.
Class 4b . .	,, ,, ,,	Electrical Apprentices.
Class 5a . .	,, ,, ,,	Fitters and Turners.
Class 5b . .	,, ,, ,,	Moulders.
Class 5c . .	,, ,, ,,	Electrical Fitters.
Class 5d . .	,, ,, ,,	Armature Winders.
Class 5e . .	,, ,, ,,	Pattern-makers.
Class 5f . .	,, ,, ,,	Transformer Erectors.
Class 6 . .	2½ ,, ,,	Draughtsmen.
Class 7 . .	2 ,, ,,	Electrical Testers.
Teachers' Preparation Class.		

The classes are kept as small as possible, and there are on an average at present thirty apprentices in each of the first four classes, and about fifteen in each of the trade classes. Classes 1, 2, 3, and 4 have two lecturers each, each branch of Class 5 one only. Each boy is expected to take full notes of the lesson, and to work examples as required. An optical lantern is used for illustrating various machines, tools, and works processes. Samples of tools, and specimens of various engineering materials in different stages of manufacture, are exhibited. There is also an equipment for electrical experiments, 110 volts direct, and 120 volts alternating current, with instruments, etc., and the usual gas and water supply for other experimental work. No textbooks nor instruction sheets of any kind are used. The arrangement of the work is left to each individual lecturer on the syllabus provided.

Condition of Admission.—When a boy between the ages of fourteen and sixteen enters the works, and desires to become an apprentice, he is interviewed, and if his education appears satisfactory, is required to work in the shop for a period of three months. At the end of that time, if he is suited for practical work, his parent or guardian and the company sign an agreement, by which the boy is "bound" as an apprentice till he is of age. At this point arrangements are made for him to commence work at the apprentice school at the beginning of the next session after this date. He has thus never more and generally less than about five months to wait before entering on a school course.

The class into which a boy is placed depends to some extent on his previous training. If under sixteen, he is generally placed in Class 1, because the continuity of the classes is valuable, and if Class 1 is omitted much good preparatory work is lost. If satisfactory, the boy is advanced into the next higher class every six months.

No boy is allowed to attend two different classes in the same session, unless under special circumstances. At the end of each session each lecturer reports fully on each boy under his charge—with respect to ability, punctuality and attendance, neatness of work, etc., and on this, together with his shop record, is based promotion. In the past, examinations have been held at the end of the session, but the results have not carried much weight, and in future may be discontinued. The boys do not "prepare" for them, and they merely serve to indicate actual ground covered, which is now ascertained in other ways.

Attitude and Attendance of Apprentices.—From the commencement it has been compulsory for all apprentices to attend the school at those hours specified for them. Since, however, the company had at the inception of the scheme a number of "bound" boys, many of them not remarkably intelligent, there was some feeling among them against coming to school. The objection very largely rested on a desire to conceal their ignorance and partly on the idea that "coming to school" branded them again as schoolboys at a period of adolescence at which they like to be thought adults. It was felt that those boys who come to school willingly are those who could be best left to look after their own education, while those who refused to attend school were those who needed it most. Thus the basis of compulsion was adopted, but several of the apprentices who showed no ability to profit by instruction were allowed to discontinue attendance. As a rule both boys and their parents see the wisdom of attending school, and the boys are anxious to come as soon as possible. The discipline of the school is largely maintained by the method of "self-government," each class looking after its own internal affairs, and the boys readily agree to deal with any member who makes normal procedure difficult by his behaviour. The method depends on the fact that the majority of boys really want to learn, and are desirous of doing so.

Attitude of the Shops.—It has already been stated that the works as a whole did not view the new scheme with enthusiasm. The mass of the workers are quite indifferent, and the only people personally interested are the lecturers, apprentices, and foremen. The foremen, who had to release a number of their boys each day for school, naturally did not feel any great enthusiasm, but on their co-operation a great deal depended. It is considered one of the major successes of the organization that many foremen are now much more favourable in their attitude. They give work—and the best work—most readily to the boys who attend school, and consider them brighter, more intelligent, and better "all round" boys than the other shop boys. They do not lose in the long run, because the period spent in school enables a boy to go back to work much fresher and more able to work effectively.

From the first the school organization has aimed at enlisting the interest and co-operation of the foremen in order to improve the general conditions of shop training. To this end, foremen were asked to lecture exclusively to the trade classes, a process which at first was more beneficial to them than to the apprentices.

Lecturers.—The provision of lecturers gave much difficulty in the early period, as the only acquaintance with lecturing most of the staff had obtained was as students at the technical institutions and universities. All the lecturers are employed by the company, either as engineers or as foremen in the shops. Many of the former are engineering graduates with considerable practical experience, and all of them have good technical training. In view of the fact that in future the school will develop into a class or group of classes for each trade, it was considered desirable to have a number of men with trade experience in training to act as lecturers. The qualification for such men must be :—

(*a*) Sound primary or secondary education.

(*b*) Reasonable amount of technical training, such as is given by advanced evening classes or part time day courses.

(*c*) Expert skill in some trade.

(*d*) Ability to impart their experience to others.

To meet these requirements, a number of young men have been selected with a view to training as lecturers, *all from among the company's trade apprentices.* The first two conditions are assured by careful selection of the men, the third by a long period of practical shop training in our own shops, and attempts are being made to secure the fourth by a special preparation class or round table, held for one hour each week, at which all the juniors are required to attend, and to which all lecturers are invited. The class is under the personal direction of the authors, and outlines of teaching methods are given with demonstration lessons, giving due consideration to the special features of trade school work. The Herbartian method is used as a basis, and the opportunity is taken to exchange classroom experience. All the junior teachers —a dozen in number—are products of the school, being the most promising apprentices who have already passed through, and they are attached at present to Classes 1, 2, 3, 4, 6, in order to gain experience from the most able lecturers. Later they will be used in connection with the trade classes. The provision of junior lecturers acts as a stimulus to other apprentices, and diminishes disciplinary troubles.

Relation to Outside Authorities.—A striking result of the introduction of the school work has been the big increase of apprentices attending evening schools. The number of boys attending evening classes out of 180 examined and interviewed before the school started was forty, i.e. about 18 per cent. The number attending out of 220, September, 1915, was 140, i.e. about 62 per cent. The relation with outside authorities is cordial, and head masters and local labour exchanges send boys to the company because of the advantages available. No home-work is set in the company's school, so that no bar to evening school attendance exists.

Social Results.—It is impossible to overestimate the value of the personal touch established now between apprentices and members of the staff. The progress of every boy is watched with great interest, and he is made to feel that this is so. An *esprit de corps* has been aimed at, with good results, considering the heterogeneous nature of the apprentice body. A committee representative of apprentices has been formed, which keeps in view the general interest. Great developments are possible in this direction, especially in connection with the social life of the apprentices.

School Hours.—All school hours are between 8.30 and 5.30. As far as possible, all classes are held before noon, to avoid fatigue interfering with the work done. Only classes for older boys are held in the afternoon. Apprentices are paid full wages for the time they spend in school, and all stationery is provided.

Rewards.—The company has not yet adopted any system of rewards for apprentices, because the principle is considered objectionable, since it is sufficient privilege to attend classes at all. There are many inducements to apprentices to work well through the avenues for advancement afforded.

Justification for such Educational Work.—It may be suggested that no individual company is justified in assuming control over such a vital matter as education, especially of trade education, when attempts may be made to give instruction not on any broad basis but only as far as the needs of that particular firm go. To this it may be replied that private enterprise in England has always preceded public effort, even in matters concerning the whole community so vitally as education, and valuable pioneering work is done in this way. On the experience so gained, subsequent policy is based. Further, the range of products of the British Westinghouse Company in mechanical and electrical engineering is so wide that the firm is in a much better position than most to give a very broad trade training.

Cost of the Scheme.—The cost of any such scheme to that outlined above is made up of the following items :—

(1) Capital outlay in equipment.

(2) Working expenses :—

(*a*) Wages of apprentices for time spent in class.

(*b*) Cost of time of lecturers. In many cases this may be taken as nil, since the work of many engineers in a manufacturing firm has to be done whether they spend any time in school or not.

(*c*) Any honorarium, bonus, or salary increase to lecturers for the extra work involved.

(*d*) Cost of fees, etc., and wages paid by the company for apprentices who attend outside day classes, or fees for evening schools, etc.

(*e*) Administrative expenses, stationery, etc.

(*f*) Salaries of permanent staff associated with the school.

(*g*) Cost of machinery and tools rendered temporarily idle, or loss of output during absence of apprentices from the shops.

Excluding item (1), and the last two of the group under (2), the cost to the Westinghouse Company for the period of eighteen months from January, 1914 to June, 1915, was about £2 13s. per head per annum, of which the cost of wages paid to apprentices for time spent in school accounts for about one-half. The cost during the present session is estimated to be about £2 15s. per head per annum, which is 4s. higher than the original estimate made when the school was planned. It is interesting to note that with nearly 300 apprentices, Ludwig Loewe's school costs £3 per head, including the salaries of several professional teachers, while with 100 apprentices the cost was £5.

Primary school instruction costs £4 per head each year, evening school instruction about £2. The cost of a scholar in a Munich day school is given as £5 16s., and in a continuation school as £5. These figures, of course, do not include any payments for school time.

Every well-organized works school requires sooner or later the services of a director, whether he be in sole charge, or whether he acts in an advisory capacity to a nominal head, and the salary a capable man would demand would increase the cost substantially on the figures given.

Subjects of Instruction.—The detailed syllabuses given in the Appendix outline the subjects allotted to each class. They are neither exhaustive nor final, and are altered from session to session as fresh experience urges the advisability of doing so.

Future Progress.—Since the aim of the school is to provide skilled workmen, a closer approximation to the ideal will be obtained when there is in the school a group of classes associated with every trade in which apprentices are employed. The preliminary classes will be cut down and the trade classes extended to secure this.

Ultimately every trade may have two or more classes definitely associated with it, and the whole of the work done in the preliminary general classes may be undertaken by the teachers of the trade classes, who will be best able to take account of the trade requirements. In this case, care will have to be taken that the instruction does not become too narrow, although most apprentices feel that the narrower the work is, and the more complete its bearing on their trades, the better it is for them.

Such an arrangement will depend upon a number of factors, the most important of which is the development of suitable teachers. A teacher of such a trade class will require to have a wide practical experience in the trade to which he confines his teaching, together with a real ability and enthusiasm for imparting his knowledge to others. The latter *desideratum* necessitates experience in teaching and knowledge of pedagogic methods, a combination which at present is impossible to obtain. The best that can be done is to secure the services of promising men who have acquired suitable workshop experience, and to give them a course of training in the art of teaching. Their services can then be used effectively for several years before they pass on to the more responsible work which they will inevitably obtain, and before they lose that vital touch with current trade practice so necessary to a real trade teacher. The most promising of their pupils can then be trained to take their places.

Numbers of Boys Apprenticed.—The number of boys actually apprenticed and receiving instruction is only a fraction of the total number of boys employed at the works, many of whom, however, are not suitable for apprenticeship. The number of apprenticed youths is increasing.

Of boys under eighteen in the works about 5½ per cent, and in the offices about 3½ per cent were apprenticed up to October, 1914.

In October, 1915, the following figures were obtained :—

Number of apprentices in works	272
Number of non-apprenticed and apprenticed youths in works	1189
Number of apprentices in offices	37
Number of non-apprenticed and apprenticed youths in offices	159

The percentages have thus increased to 23 in the works and offices, an augmentation solely due to the existence of the trade school. Of these 309 apprentices 260 come from primary schools and 37 from secondary schools. 250 of these were in attendance at school.

Shop Training.—The question of suitable shop training is receiving earnest consideration with a view to enabling apprentices to gain practical training in the most favourable manner. This necessitates a schedule of the requirements of each trade and of the experience which a tradesman should gain. A course can then be mapped out in which this can be obtained as far as the work passing through the shops allows. For a tradesman who will require to do machining operations a course involving the making of certain specified articles is likely to be less satisfactory than a period of time on a number of different machines, as in the latter case a more intimate knowledge of the possibilities and limitations of each can be gained by going through a variety of work on it. In the case of these tradesmen a course of work is best expressed in terms of the machines on which they have to work. For those men whose work is done chiefly at the bench, as mechanical fitters, the course should be in terms of a series of operations rather than a series of articles which should be made. The modelling of such courses requires considerable time and the assistance of trade experts to be effective, and special precautions have to be taken to see that each apprentice is able to cover the ground. In order to combine the advantages of the ordinary workshops for trade training with the advantages obtainable from specific tuition in trade operations, the British Westinghouse Co. is trying a method whereby in certain departments apprentices are allowed to work occasionally for one hour beyond the normal time, during which period they are definitely taught the correct way in which processes are carried out. This work is treated as ordinary overtime, and each apprentice obtains two such periods per week. During the daytime opportunities are available to practise such processes. Further, a schedule of trades has been drawn up, and those departments which do not offer reasonable scope for the practice of these trades are closed to apprentices. Where more than one department is concerned with a given trade, apprentices are enabled to pass from one to another as their experience and conduct warrants.

CONCLUSION.

As an aftermath of the present crisis a keen commercial war may be anticipated between all industrial nations, the effect of which will be to stimulate the development of economic methods of manufacture and enforce the application of every available means ensuring efficient working in industrial processes. The increasing foreign debt of many European countries can only be liquidated by export of home products, a market for which must be obtained in the first place by economic manufacture to a degree which permits successful competition in foreign markets.

At the present time the most fruitful and promising field for the development of this increased efficiency lies in the adequate training of those workers who make up the rank and file of the industrial world. The economy consequent on this training affects in a greater or lesser degree the individual worker, the industry, and the State.

Grouping of Industrial Workers.—It has been shown that the progress of industry has been responsible for the introduction of two distinct classes of workers—manual and non-manual—and that the growing complexity of industrial knowledge renders it increasingly difficult for a worker in the former group to pass to the latter. Consequently, it is extremely desirable that current conceptions of the nature of the training required for each group be modified in accordance with these new conditions, involving the abandonment of the idea that the same training is suitable for each, and the introduction of a separate preparation for each based on a careful analysis of the function of the members of each group. This will involve radical changes in such conceptions regarding the training of the manual workers, which have hitherto failed to keep pace with industrial evolution.

Present Position.—While existing training has retained the form, it has lost the substance of mediæval apprenticeship. It has failed to adapt itself to the changing requirements in regard to greater breadth of knowledge and a different character of experience. The lack of a clear conception of these requirements, and the temptation to exploit youths for immediate gain, have combined to lead manufacturers to pay insufficient attention to the need for training. An effective system will provide for the education of those boys destined to work in the industries on lines which will lead them to respect manual labour, at the same time fitting them to take it up on leaving school without loss of time; will furnish a means for the proper selection of the most intelligent youths for the highly skilled trades, and will permit a period of apprenticeship coupled with a continuation of education on lines calculated to render the apprenticeship of the greatest possible value, bearing in mind its aim in the production of skilled workmen.

Pre-Vocational Education.—Prior to the school leaving age, each boy in the primary school should receive a training which will enable him readily to assimilate the knowledge and experience of his future craft. The few scattered attempts to provide this preparatory instruction in Great Britain, such as are represented by central, junior technical, and trade schools, might advantageously be replaced by a systematic plan on a much broader and more comprehensive scale. It is suggested that the existing system of primary education can effectively be modified to this definite end by the introduction of senior standards of instruction taught by specially qualified teachers. These classes will provide a groundwork for subsequent vocational training by giving a bias to those subjects already in the curriculum which are peculiarly necessary to the industrial worker. In the beginning, groups of certain related widely distributed and highly skilled trades should be examined, and the number of trained youths required each year to keep the trade in a high state of efficiency determined. Special provision must be made for these in the primary schools, the number of boys being trained being the number required to feed the trade together with a percentage for wastage, which will be decided by experience. If broad groups of trades and occupations are dealt with, there will still be a considerable elasticity which will accommodate other factors such as personal choice, physical suitability, etc. The original selection, if the other factors permit, should be made on a basis of general intelligence, and thus a gradual process of classification will be set in motion which will result in any given worker finding an occupation most suitable to his mental capacity.

The segregation of those boys in the primary school who show aptitude for industrial work will react to facilitate selection by directing the serious attention of all youths to a vocation.

Vocational Selection.—However skilfully planned a system of pre-vocational training may be, the best possible results will not accrue unless the youths trained possess inherent fitness for the work. Little evidence is available to indicate to what extent the average boy can pursue any vocation successfully without reference to his natural "bent". Due to existing lack of refinement, our immature methods of selection and training result in a comparatively low working efficiency, even from a fully trained worker. It is thus possible to place any boy in almost any situation without results sensibly worse than those obtained at present. In view of the fact, however, that the characteristics of any boy are different from those of another, and that they, when properly developed and utilized, determine his value as a worker, vastly improved results may be expected if these characteristics can be accurately estimated and his *métier* accordingly determined.

Close observation of the pupil in the primary school, especially during the later period, by teachers or other competent persons, is suggested as an immediately possible means of discerning these characteristics. While the problem is a psychological one, experience and knowledge are wanting in interpreting psychological tests and in basing selection on them, although they may constitute an invaluable guide.

The most effective method possible at present seems to lie in the selection of men on a broad basis, together with the collation of experience on the part of the employers in the engagement of workers and the formulation of the requirements of each individual post. Further, the period of probation in many trades can be utilized much more efficiently than is at present the case in fixing capacity to undertake a definite kind of work. If psychological tests are applied in addition, it may be possible to draw a parallel between the results of such tests and actual abilities, and so pave the way for a completely scientific method.

Apprentice Training.—Much benefit will accrue to skilled trades, and training for them can be made much more specific if each could be accorded a definite status. Individuals unqualified to follow a special trade could then be prevented from using the trade designation, just as unqualified dispensers are not allowed to use the name " pharmacist ". The necessity for training before the practice of a trade can be successfully undertaken has always been tacitly recognized. Some form of apprenticeship, that is, a preparatory period during which a youth undergoes specific training which will enable him to follow his trade in an efficient manner, must be retained, and the necessary trade qualification might consist in such a period leading to a practical test of capacity before a representative body of employers and workers. In some highly skilled trades the length of apprenticeship would of necessity still be very long, but in some cases could with advantage be considerably shortened. Five years may be considered a maximum for all cases. The introduction of machinery has rendered the superlative skill of the craftsman of a past generation unnecessary, but the growing complexity of the product renders a very wide knowledge of the scientific principles underlying industrial processes exceedingly desirable if the work is to be handled in any other than an empirical manner. Although, therefore, a high degree of manual skill is still required, less time is required in its acquisition, but coupled with this, however, due provision must be made for the extra knowledge which is necessary.

Because technical school instructors are out of touch with latest industrial developments; because the equipment of a technical school can never equal the resources of a real workshop; because the technical schools concentrate on assisting the capable man to rise, thereby neglecting the average man, such schools cannot as at present constituted provide instruction for artisan students. Because the experience gained in the shop is unsystematized; because conditions are not conducive to proper teaching, however sympathetic supervision may be, the shop is not the best place for such teaching. The advantages of quietness, economy, and suitable environment can best be secured by utilizing a schoolroom. Since it is vitally necessary to obtain the co-operation of trade experts, such a schoolroom is best situated on the premises of the works undertaking the training of apprentices. Subsidiary advantages accrue in the avoidance of evening school exhaustion; in the development of a personal touch between apprentices and the staff of the works, and in the ease with which suitable youths can be selected for other employment. Parallel with a course of instruction in the trade school, arrangements should be made for all apprentices to receive thorough training in the practice of their craft in the shops.

That it is possible for an industrial organization to build up and carry on such a school successfully has been fully proved by the work during the last two years of the Trade Apprentice School outlined in Chapter XII.

The Plea for Individuality.—When comparisons are drawn between industrial and other conditions in Great Britain and in Germany, it is invariably considered that the extreme systematization which obtains in the latter country tends to stifle all individuality in the worker, whereas conditions in the former country allow the individual mind free play. It is abundantly evident that the organized direction of human effort to a common end possesses enormous advantages over a chaotic condition in which each unit is allowed to be self-directive. On the other hand, the independent value of each unit is undoubtedly less, owing to the tendency towards stultification of growth. The problem resolves itself into finding a compromise which yields the best possible results from a systematic point of view and an appreciation of the value of system as far as it is consistent with our individualistic point of view.

The plea for individuality in industry as a national characteristic may do considerable harm if it fails to recognize the gain accruing from a suitable degree of organization. Those workers who stand most in need of industrial training are precisely those who fail to take advantage of such voluntary facilities as at present exist, and moreover are those who are responsible for the distrustful and conservative character given to the British workman.

If this can be altered, there is every reason to believe that Britain can regain her old position as leader in the industrial world. Her educational system is not exclusive like that of Germany, and talent has opportunities of forging ahead in a way not yet realized even in America. Many industrial troubles which she has weathered have yet to be faced by her greatest competitors. Industrial conditions are far more stable than those in the States, and the superior resource of the Britisher should, with suitable industrial training, more than counterbalance the efficiency of German methods.

The Wider Outlook.—Important as is the problem of industrial training from the point of view of national prosperity, the material aspect forms only part of a much wider problem, that of training for citizenship. Industrial training forms an admirable basis for such training, because provision of a means of earning a living is the first step under existing economic conditions towards a stable society of self-respecting individuals. It develops those virtues of discipline and self-control which distinguish a good citizen, and combats many tendencies in the modern youth which are deplored by many observers.

The intimate contact brought about by such a scheme between employers and employed during the apprentice period may establish such a condition of mutual regard as to provide a means whereby labour differences can be adjusted before they become so great that a real basis for settlement is too difficult to find. Modern labour unrest is nowadays only partially a question of wages, and not infrequently a question of monotony which results from the very restrictions under which men work. Suitable industrial training will enable workers to adapt themselves to a much wider range of work if Trade Unions will co-operate in facilitating this. These organizations can do much valuable work by realizing that the individual will benefit as a result of such training, and by acting accordingly, thus developing a national rather than a more restricted class policy. There is every reason to believe that, with the stimulus afforded by a system for training workmen, present tendencies towards beneficial co-operative effort can be developed until there is a strong sense of loyalty between the workers and the organization, making the works a powerful factor in the realization of a better life for the employees. The presence of a body of apprentices all receiving instruction provides an excellent opportunity for creating an *esprit de corps* which may express itself in various activities, such as the provision of a works club or recreation room, library, athletic sports and outdoor games, or in the arrangement of social functions and holiday trips, etc. An almost incalculable gain can be made by eliminating the existing feeling of mistrust, which is one of the worst features of the British industrial system, and this can be done without introducing any of the excessively paternal features noticeable among some firms in the United States.

Although an extended system of industrial training may be adopted by individual employers as another weapon to assist in meeting competition its incidental advantages to society as a whole are so patent that such training becomes a matter for national concern, particularly in view of the now acknowledged interdependence of the whole industrial fabric and the State.

APPENDICES.

APPENDIX I.

SYLLABUSES OF CLASSES HELD AT THE BRITISH WESTINGHOUSE WORKS SCHOOL.

CLASS 1. SYLLABUS IN ARITHMETIC.

THE ground covered by this syllabus is designed to enable boys to increase their facility in arithmetical calculation, and to make this of real value by emphasising the practical uses of calculations rather than to impart fresh knowledge beyond the range of the higher standards of the primary school. To this end the work consists largely in the working of practical shop problems which arouse interest by the direct bearing they have on the various trades. Scarcely any money problems, except wage determinations, are introduced. Too much importance is not attached to method, provided the answer can be obtained correctly; the correct and best method is always shown by the teacher, but a boy is not forced to abandon one he may already possess if it is satisfactory. Problems requiring judgment and careful estimation—involving the use of common sense—are set in addition to the straightforward calculations. A knowledge of the four rules is assumed.

Vulgar Fractions.—The four rules applied to fractions are required, together with cancelling and Least Common Multiple. Only those fractions such as are found on a simple rule need be considered, halves, quarters, eighths, sixteenths, etc., with possibly thirds, fifths, and twelfths. All others must be converted to and used as decimal fractions.

Decimal Fractions.—The four rules applied to decimals. The decimal equivalents of the common subdivisions of the inch are important, also their reconversion to fractions. No decimal places beyond three need be considered, all answers being worked to four places. Recurring decimals are not required.

Practical Illustrations of Vulgar and Decimal Fractions.—Determination of a man's hour rate when given his weekly wage, and of the weekly wage from the hour rate. Overtime rates for day work. Rates for night work. Determination of wages for any combination of rates and hours. Effect of late-coming. The micrometer gauge. Limit gauges.

Mensuration.—The whole subject of mensuration is approached through the necessity for obtaining the weights and costs of shop materials and products. Given the densities of such materials as wrought or cast iron, steel, copper, concrete, timber, etc., the weight can be found from the volume. If the cost per unit of weight is known, the cost can be found. Actual prices should be used of actual materials.

It will be necessary for apprentices to learn, incidentally, some plane geometry—parallel lines, angles, right angles, the degree, squares, rectangles, triangles, circles, etc., and the simple solids.

The perimeters and areas of the following figures should be done: squares, rectangle, triangles—right angled, equilateral, etc.—circle, annular ring. Polygons should be considered as grouped triangles.

Volumes of the following solids: cube, square, rectangular and triangular prisms, cylinder.

The whole subject will afford excellent opportunities for revising vulgar and decimal fractions.

Drawing.

The general aim of this course is to provide apprentices with a knowledge of how to read blue prints. They are not required in their daily work to construct drawings, and hence no instruction in the use of drawing instruments is given. It is considered of much greater importance that boys should be able to sketch freely.

What a blue print is for. Other methods of conveying ideas from one mind to another, with advantages and disadvantages of each :—

(*a*) Verbal instructions.
(*b*) Written memoranda.
(*c*) Copies in material.
Superiority of method of drawing.

Picture drawing (isometric and oblique projection). Boys will draw one or two simple solids in both of these methods. They soon see that they are applicable to very simple and non-curved parts only. Another method has to be adopted for complicated machine parts.

Plane. Flat and level. Kinds of planes—horizontal, vertical, inclined. The surface of still water. The horizon. Meaning of "parallel". XY or ground line. Boys should fold a piece of paper into two planes, label them vertical and horizontal, and mark in the XY line.

A plane paper can show *one surface* of an object only in one view. In a simple solid, six surfaces require three views, two, however, being usually sufficient.

The *idea of projection*. The relation of the secondary views to the primary view.

Sections. How to show inside details. Rules for engineering sketching. Actual creasing of paper and drawing of simple objects. There should be many of these examples, and a standard of neatness and accuracy should be aimed at. No ruling or measuring should be allowed, and the parts should be in fair proportion. Every drawing should be accompanied by a rough sketch, showing the same object, by the picture-method. Lantern slides and photographs of solids shown in drawing should be freely used.

Dimensions. What they are, and how they are put on.

Some of the conventions of machine drawing (shading, etc.).

Conventional drawing of nuts and bolts, screw threads, etc., to facilitate understanding of blue prints.

How a blue print is made. (Show the process.)

How to deal with errors. Measuring blue prints.

Illustrations of the common shop method on actual blue prints, drawn in an increasing order of difficulty, designed to give practice in reading blue prints. The series of specially prepared prints should give ample scope, leading ultimately to actual shop drawings. Boys should sketch views of parts presented to them. The utmost practice must be given in actually *reading* the prints. In some cases errors of projection have designedly been made, and boys should be made to find them out. They should be asked to give the distance between two points in the drawing if it is obtainable, either by adding or subtracting given dimensions or from *another view*. A lantern slide diagram will facilitate this. They should sketch solid views from the projections, and draw projections from the solid or a picture of it, the sole aim being to teach them when they *see* a pair of projected views, to have in their mind's eye, the actual solid.

Note.—In the above syllabus the usual method of teaching orthographic projection is considerably modified, because the common method used in schools is not used by engineers. The words "primary view" and "secondary view" are used instead of plan and elevation, because the view conventionally considered a plan may, on a works drawing, appear as an elevation. More commonly it is impossible to say which of two views is the plan. The main point is to insist on the fact that the two views represent one object, and that there are certain definite relations between them. The names which may be applied to either are immaterial. To assist this syllabus, a series of blue prints has been specially prepared, the earlier ones giving a number of plane figures, and later ones projections of simple solids and machine parts. Care has been taken to use standard printing and figuring, so that the series leads up through a number of increasingly difficult examples to the use of actual shop drawings. The actual parts and lantern slides of prints are freely used to make collective teaching easier.

General Course.

This period each week is devoted to a series of lectures which are designed to increase the general knowledge of apprentices, and to give them a broad interest, not only in the operations of the trade in which they are most concerned, but in others. Apprentices should be encouraged to ask questions relevant to their work and the difficulties it presents, which should be answered in class if of general interest. This class is the only one which at present can be devoted to instruction on a broader basis than that imposed by the trade itself.

The aim and object of the school contrasted with ordinary technical schools. Trend of legislation on the question. What Germany and the States are doing. How to get the maximum benefit out of the school. Note-taking, reading out of hours, interest in trade papers.

Trade education not a complete education. Value of general knowledge. Hobbies, model-making, photography, nature study, etc. *Scouting*. Explain its aims.

Buying and selling. Raw materials. Arrangement of works. Progress of material through the shops. Drawing and designing office. Foundry. Pattern shop. Smithy. Fitting and machine shops. Erecting. Inspecting. Testing.

Safety first. Danger of careless and ignorant handling of running machinery. What to avoid. Safety devices provided. Their use and abuse. What to do in case of accidents. How to get help—get expert attention for even trivial things—cuts, eye troubles, etc. Simple treatments in emergency for slight accidents. Whom to report to, etc. Elements of physiology —skeleton, internal organs, muscles, brain and sense organs. Effect of injury to certain parts.

Simple notions about electric circuits. Current. Voltage. Insulators. Conductors. Fuses. Dangers of electricity. What to avoid in working near bus bars, circuits, etc. What to do in case of accident.

Burns. Nature, danger, simple treatment. Poisoning. Nature, danger, simple treatment. Various poisons, works substances (red lead, etc.). Symptoms. Emetics and antidotes.

Fire—dangers of. Causes. Danger of carelessness. Combustion. Burning. Rusting, nature of. Fire hydrant, nozzles, hoses, buckets. Use of sand, water, gas for fire extinguishing. Patent fire extinguishers.

General Workshop Practice. Pattern-making.—What a pattern is. How the pattern-maker differs from the carpenter or joiner. *Materials* used by the pattern-maker. Timber—warping and shrinkage. Features of yellow pine and mahogany. Tools used by the pattern-maker. The importance of machine tools in the shop—band and circular saws, planers, trimmers, and lathes. Methods of securing permanence of form and ease of moulding in patterns. Open joints—boxed patterns—halvings—lagging up—segmental construction. Localizing and hence minimizing change of form. Jointing. Tapering patterns. Metal patterns.

Moulding and Core Making.—Jointing of patterns to secure withdrawal from sand without disturbing or fracturing it, to permit cleaning of mould to insert cores. Importance of proper jointing. Moulding. Qualities of moulding material—non-inflammability — porosity — coherence — abundance—cheapness. Selection of sand. Varieties of sand. Modification of qualities of clay sands by addition of hay and coal dust. Green sand. Dry sand. Moulding operations. Importance of correct ramming. Reinforcements of weak parts by "gaggers". Gates. Risers. Cores. Venting. Core boxes. Importance of correctly tapering the pattern. Reference to loam moulding.

Smith's Work.—Characteristics of cast iron and wrought iron. How the latter can be made from the former. Uses of cast iron and wrought iron in engineering. Rolled sections. *Tools* of the smith. Importance of the influence of qualities and characteristics of a material in settling the nature of the tools used on it. Smith's hammers. Welding.

Machine Shop Work.—The broad difference between various machine tools in function. Difference between rotary and reciprocating tools and the advantages and disadvantages of each. Tendency in modern engineering to abolish reciprocation. Vertical and horizontal tools. Following tools as instances of various types—lathes (plain, screw-cutting, turret). Automatic machinery, boring mills, drilling machines, planers, shapers, and slotters. The common features of all these tools. Milling and grinding. Their great and growing importance. Possibility of variation and adaptation to do work of any kind, previously done on other types. Tooling allowances—marking out.

Erecting. Testing. Inspecting.

Note.—It may be added that further work in manufacturing economics is given in the syllabus for Class 4, q.v. Further work is contemplated in the elements of factory organization, the Factory Acts, Insurance Act; the cost of labour, material, and overhead charges; the importance of delivering goods to time and the factors which retard delivery; banking and thrift; joint stock companies, etc. Particularly, it is intended to introduce the importance of avoiding waste of material, of time, and of effort.

The routine of a large works touches the life of the individual apprentice at so many points that it would be an exceedingly easy matter to expand this course and make it the centre of a course dealing with the broader citizenship aspect of vocational training. Starting with the trade, it would be possible to deal with its history in the gradual development of industry, mediæval craft guilds, and to include material such as the Factory Acts, the evolution of joint stock enterprise, national insurance, thrift, etc. In this way a natural channel can be made from that which vitally interests an apprentice, trade knowledge, to that which it is difficult to impart before the adolescent period, but which all future citizens should know; the elements of the constitution, how laws are made and administered, local government, taxation, and the relation of industry to other great branches of human activity and to the State. The whole subject is treated admirably by Kerschensteiner in Chapter III of "Education for Citizenship".

CLASS 2. MATHEMATICS.

This syllabus will consist mainly in arithmetic. There will be no formal algebra, but in some problems the symbolic method should be applied, and apprentices will soon gather the simpler manipulations of symbols if utilized as part of the arithmetic, especially in mensuration. *No contracted methods are to be taught.*—Teach boys to multiply and divide in full and cast off unnecessary figures.

Constant revision of vulgar and decimal fractions in more difficult problems where their introduction is just the *means* to the end, the answer, and not ends in themselves, and of mensuration.

(*a*) *Revision of Decimal and Vulgar Fractions.*—Addition, subtraction, multiplication, and division.

(*b*) *Mensuration.*—Revision of areas of triangle, rectangle, and circle. Volumes of cone, cylinder, and sphere. Common surfaces. Taper on shafts, truncated cone, wedges. Dimensions, weights, and costs of material to be drawn from stock for specified purposes.

(*c*) *Micrometer, Vernier, Limit Gauges.*—Their application in the shop.

(*d*) *Mathematics of Science Class.*—Examples on expansion and contraction due to heat and cold. Examples on Ohm's law, etc.

(*e*) *Wage Determinations and Bonus System.*—The determination of a week's wages under any specified conditions for day or night work on an hour rate, or piece-work basis. Explanation of the Westinghouse bonus system. Examples should be taken from actual clock cards, and the way the cost clerk works them out explained.

MECHANICS.

This course should avoid as far as possible the orthodox methods, definitions, and scientific expressions of the textbooks. A realisation of a mechanical law should be built up by pointing out the consistency of a number of facts relating to it, drawn from everyday experience.

(*a*) *Force.*—Develop the idea of force by some such consideration as a body in motion. It will ultimately come to rest, and the action bringing this about is known as force. How soon the body comes to rest, depends on the nature of the resistance. Therefore, develop the idea of magnitude, and also direction of force.

(*b*) *Work and Power.*—Elementary considerations of work. Work done by a force, and work done against a force. Foot-pound, horse-power, watt, kilowatt. Their relation and calculations on same.

(*c*) *Moments.*—The idea of moments. Magnitude and direction, leading up to consideration of levers.

(*d*) *Levers.*—The lever as a machine for overcoming large forces with little effort. Shop applications as crowbar, safety valve, governors, etc. Use in scales, weighing machines. Orders of levers as typified by the simple balance, the wheelbarrow, and safety valve in which the steam pressure acts against a weight or spring. Double levers, as shears or nut-crackers. Calculations on levers.

(*e*) *The Inclined Plane.*—The uses of the inclined plane, and its application to workshop practice, e.g. removing a pulley from a shaft, driving out a key with a drift, raising trucks over steps, and obstacles such as cables, etc. Wedges. The wedge as a double inclined plane. Its use for separating materials, splitting timber, etc.

(*f*) *Friction.*—(1) Consideration of friction on the level. Nature of surfaces as affecting friction. Compare moving jobs on a marking off table to pushing a box on the floor.

(2) Friction on the inclined plane. Relation between friction and the weight being moved. Limiting friction. Coefficient of friction. Calculations on friction.

(*g*) *Efficiency of Simple Machines*, as wheel and axle, screw, pulley blocks, followed by calculations on above, illustrating again the lever, and inclined plane.

(*h*) *The Fallacy of Perpetual Motion.*—The law of conservation of energy could very well be emphasized here, although the principle should be pointed out at every point in the course where it is relevant to the work in hand.

Elementary Science.

This course is purely descriptive, any relevant arithmetical examples being covered in the mathematics hour. It is not intended to be exhaustive, but should aim at providing common-sense explanations of everyday phenomena, particularly those which occur in the shops. Experimental demonstrations may be given, but in view of the abundance of actual illustrations occurring in shop practice, the latter should be referred to and seen whenever possible.

Apprentices should be encouraged to ask questions, answers to which may be given fully at the appropriate point in the course.

Heat.—States and properties of matter. Hot and cold bodies. Conduction. Temperature. Distinction between temperature and heat. Effects of heat. Expansion. Thermoscopes. Thermometers. Conversion of Fahr. to Cent. and vice versa. Pyrometers. Examples and application of expansion, and force exerted in the same.

Peculiar behaviour of water at 4° C. Burst water pipes. Expansion of gases. Boyle's and Charles's laws. Atmospheric pressure. Barometer. Simple explanation of working of steam engine and condenser. Notions of specific and latent heat. Case of water. Change of state. Fusion. Freezing mixtures. Evaporation and boiling. Boiling-point. Effect of pressure on boiling-point. Vapour pressure. Condensation and distillation. Freezing by evaporation. Ice-making. Transmission of heat. Conduction. Convection. Radiation. The safety lamp. Convection currents. Heating of a house by hot water. Ventilation of rooms.

Radiation. Heat insulation of pipes.

Burning and combustion. Oxidation and rusting. Spontaneous combustion. Fire and methods of extinguishing it.

Magnetism.—Magnet poles. Law of magnetic attraction and repulsion. Methods of magnetization by electricity. The electro-magnet. Compound magnets. Destruction of magetism. Steel for magnets. Bar and horse-shoe magnets. Fields of magnetic force, and use of iron filings. Behaviour of soft iron in magnetic fields. Screening. Compass needle.

Electricity.—Simple description of Leclanché cell. Accumulators. Dry cells. Resistance. Electromotive force and potential difference. Ohm's law. Specific resistance. Effect of temperature on resistance. Insulators. Resistances in series and in parallel. Shunts. Cells in series and in parallel. The electric bell. How electricity is made. Principle of the dynamo and motor. Mechanical and electrical energy, and their conversion one into the other. The electro-magnet, commutator, armature, brushes, etc. Function of each. Different types of dynamo winding, and use of each. Advantages of electrical over mechanical transmission. Shop examples of effect of current. Fuses, lighting, methods of distribution. The incandescent and arc lamps. Electric power. The watt. The B.T.U. and horse-power. Alternating and direct current. The motor generator. Transformers.

Class 3. Mathematics.

In this class the work of previous Classes should be revised in the working out of difficult examples, especially in Fractions, Decimals, and Mensuration. As far as possible, methods used in the works and the trades in buying metal sheet, wire, etc., should be considered, so that boys shall become familiar with actual shop methods of calculation, although such methods are cumbersome and unscientific. The manner in which some of the commoner formulæ of the engineering pocket books are obtained may be given, so that apprentices may be independent of such rules.

(*a*) *Ratio and Proportion.* — Application to change wheels and pulley speeds.

(*b*) *Areas and Volumes* of similar figures and solids. Ratio of areas of circles. Similar castings.

(*c*) *Percentages.*—Efficiency expressed as a percentage.

(*d*) *Graphs.*—The value of the graph as a visual demonstration of variation, such as weight of material in stock at specified dates. The idea of change. Graphical representation of simple equations. Straight line curves. Other simple curves taken so far as they can be applied to simplify in boys' minds what they have previously learned. The work should be designed to convey the general idea of graphical representation rather than to be a formal course in graphs.

(*e*) *Use of Logs.*—The methods of using logarithms will assist the arithmetical work to a large extent. A little preliminary work on *powers* of numbers and then the use of tables to multiply and divide and find powers and *square* roots. Only numbers such as occur in practice need be considered. If time permits, the use of the slide rule may be explained.

Mechanics.

The syllabus should be treated in no way formally, but should be an investigation into the strength of everyday shop materials in the common shapes, together with friction and lubrication, which should be dealt with fairly fully. Thus there should be no specific formulæ for bending moments when dealing with bending. It is sufficient, for instance, to let boys realize that a centrally loaded beam will break more readily (other things being equal) than the same load evenly distributed; and that it is better to build in the ends of beams.

(*a*) *Friction.*—Revise friction of solid bodies, and the conditions governing it. Rolling friction. Fluid friction.

(*b*) *Lubrication.*—Necessity and purpose of lubrication. Types of lubrication employed in the shops. Forced lubrication. Choice of lubricating systems. Properties of lubricants. Flash points, etc. Choice of lubricants.

(*c*) *Tension and Compression.*—Examples in shops: connecting rod, bolt, tie rods, wire rope, press, work held in vice, strut, armature and transformer stampings, ram, columns, etc. Tensile and compressive stresses. Examples.

(*d*) *Stress and Strain.*—Brief general survey of the behaviour of materials under stress and strain. Elastic and plastic conditions. Permanent set. Elasticity. Graphical illustrations of the relation between stress and strain.

(*e*) *Breaking Stress.*—Values for different materials. Factor of safety. Shop exercises.

(*f*) *Bending.*—Cases occurring in the shops, e.g. pressure of tool on lathe, pulley on shaft, etc. Nature of a bending stress. Tension, compression, and neutral axis. Examples: girder, reinforced concrete, etc.

(*g*) *Shear.*—Analogies between the bending actions produced by punching, cutting, and shearing. Examples: belting, riveted joints, etc.

MATERIALS.

Syllabus should be purely descriptive, assisted by slides, diagrams, and *specimens of the actual material* in each case. The material should be handled by the boys, and their ability to distinguish different shop materials frequently tested.

PROPERTIES OF MATERIALS.

Iron and Steel.—Iron. Natural occurrence. Smelting in the blast furnace. Pig iron. Cast iron. Characteristics. Varieties and composition. Contraction. Puddling. Wrought iron. Bessemerizing. Mild steel. Cast steel. High speed steel. The difference between the irons and the steels. Commercial varieties of iron and steel and their recognition from samples. Prices of the same. Miscellaneous processes in iron manufacture. Addition of aluminium and manganese in iron and steel castings. Chilled castings. Case hardening.

Annealing. Plate bending. Rolling. Dies. Drilling. Riveting. Tempering. Hardening. General heat treatment of steel.

Copper.—Commercial forms. Reference to smelting and the profound difficulty of getting pure copper. Characteristics. Reason for its use in electrical machinery. Price. Urgent need for economy in the use of copper. Autogenous welding. Works grades of copper.

Aluminium.—Its growing importance as an electrical conductor. Weight. Cost.

Tin, Lead, and Zinc.—Tinplate. Terneplate. Galvanized plate.

Alloys.—The difference between a mechanical mixture and a chemical combination. Nature of alloys and their uses. The advantages and disadvantages of alloying. The effects of alloying on electrical conductivity. Brass. Gun-metal. White-metal. Bronze. Manganese bronze. Muntz metal. Aluminium bronze. Solder and soldering. Brazing. The blow pipe.

Timber.—Wood. The difference between organic and inorganic materials. Fibres. Structure of wood. Felling of timber. Seasoning. Warping. Shrinkage. Natural versus artificial seasoning. The distinction between hard and soft woods corresponding in the main with the distinction between coniferous and non-coniferous trees. Characteristics. Typical examples. Soft and hard woods. Soft woods. Canadian yellow pine. European red deal. Hard woods. Mahogany. Beech. Oak.

Insulating Materials.—What an insulator is. Glass. Ebonite. Mica. Rubber. Wax. Fibre. Asbestos. Marble. Slate. Porcelain. Empire cloth. Cotton. Rope paper. Leatheroid. Fuller-board. Presspahn. Oils. Fuel oils. Lubricating oils. Insulating oils. Varnishes. Lubricants other than oils.

Miscellaneous Materials.—Coal. Coke. Glue. Cement. Red lead.

Class 4a (Mechanical Apprentices).

It is a matter of some difficulty to give a syllabus for this class, which is intended to develop to a junior trade class, but the matter must be *practical*, i.e. a direct application of previous teaching in the mechanical departments. It is necessary for all apprentices to possess a fund of knowledge which all men pick up in a workshop, but which it is desirable they should acquire in a scientific way, and to know the underlying principles of the mechanical trades other than their own. Great benefit will result if on every possible occasion the causes for effects be pointed out, so that the effects are not taken for granted and causes discovered independently by apprentices in new problems. It is also desired to make a special feature of the importance of avoiding waste, whether in time, material, or effort, and a few lectures on the economic side are provided for in the syllabus.

Occasionally the recapitulation of previous work is advisable, especially in a few calculations which may be given from time to time, if relevant to the work in hand.

Transmission of power by belts. Belts and pulleys. Fast and loose pulley. Starting and stopping. Speeds of pulleys. Transmission of power by gearing. Change wheels. Screws and screw cutting. Reciprocation. Quick returns. Hand and machine tools. Cutting-tool edges. Feeds and speeds. Calculation. Milling, boring, turning, grinding. Emery wheel. Grindstone. Care of tools. "Safety first." Lubrication. Friction.

Precision measurements. Micrometer. Vernier. Limit gauges. Machining allowances. Marking out and measuring.

The work carried on in the various departments: Designer's office, Drawing office, Pattern shop, Foundry forge, Machine shop, Testing department. Inspecting. Packing.

Explanation of working of Gas engine, Steam engine, Turbine, etc. Motors and Dynamos.

Calculations.—Time to plane a casting. Weight of material removed. Weights of castings and forgings. Cost of doing work. Cost of material. Speeds of shafts. Screws. Geometry of marking off.

Works Economics.—A modern company. Team work. Cost of a job. How the cost is made up. Labour, material, factory expense. Commercial expense. Factory cost. Commercial cost. Profit. Selling price. Actual examples. Carriage. Insurance. Packing.

Principle of interchangeability in modern engineering. Principle of standardization. Advantage of wholesale manufacture. Capital. How it is lessened by depreciation. Sinking fund. Effect of quicker production on cost. Waste utilization. Progress of work through the shops. Lay out of the works facilitate this.

Class 4B (Electrical Apprentices).

This class provides an elementary course in Electricity for apprentices on the electrical side of the works. The course is of a practical character, aiming at a popular explanation of everyday phenomena rather than at theoretical accuracy. The practical questions of wiring, connections, and use of instruments and the dangers of electric currents receive attention, as well as the relative values of various insulators and their special uses, and the uses of various kinds of electrical machinery.

A few calculations are done from time to time, if relevant to the subject in hand.

E.M.F. and current.
Resistance. Ohm's law. The electric circuit.
Use of ammeter and voltmeter.
Personal safety in handling electrical apparatus.
Series and parallel circuits.
Heating effect of current. Examples in practice.
Magnetic effect of current. Examples in practice.
Electric lighting. Wiring schemes and connections.
How a dynamo works.
Types and construction of modern dynamos.
Ways of connecting field coils and results obtained.
Limits to output of dynamo. Meaning of efficiency.
How a motor works.
Behaviour of motor with different field connections.
Work for which each type is used.
Starting gear for motors. Methods of varying speed of motors.
Three-wire system. Storage batteries. General treatment.
End-cells. Boosters.
Principles of ammeters, voltmeters, and watt-hour meters.

Alternating currents. How E.M.F. is generated in alternator.
A.C. instruments and how used.
Transformers. Three-phase system.
A.C. motors and rotary converter.

This syllabus is completed by the matter on works economics already given under 4a.

Trade Class for Machinists and Fitters.

Lessons 1.—General talk on the needs these apprentices feel.
" 2-3.—Some things which affect economical manufacture.
" 4-21.—Drawings and sketches.
" 5.—Practical shop points in the use of drawings.
" 6.—Measuring and gauging.
" 7.—A practical demonstration on marking out.
" 8.—Use and care of machine-cutting tools. Grinding and tempering.
" 9-32.—Common shop errors in machining and fitting details illustrated.
" 10-35.—Erecting and lining up large machinery.
" 11.—Practical points in outside erection.
" 12-13.—The arithmetic of screw cutting.
" 14.—The principles of machine-cutting tools.
" 15-29.—Common shop materials and methods of working them.
" 16-27.—Gas engine starting, running, and indicating. Demonstration on a small engine.
" 17-26.—A practical demonstration in filing and scraping.
" 18.—Some special tools.
" 19.—Starting and running a steam plant.
" 20.—Examination.
" 22 to 25.—Practical demonstrations on lathe work.
(*a*) Plain and taper turning.
(*b*) Boring feeds and speeds.
(*c*) Screw-cutting—various types of thread.
(*d*) Chucking and setting up.
(*e*) Universal work, gear cutting, slotting, etc.
" 28.—Essential features of English and American lathes (illustrated).
" 30-36.—Revision of previous work.

Lessons 31.—Practical rules in workshop mathematics.
„ 33.—Special machining.
„ 34.—Points in fitting electrical gear.
„ 37.—Practical demonstration on knotting and splicing for erectors.
„ 38.—Practical demonstration on hardening and tempering.
„ 39.—Practical demonstration on rigging for erectors.
„ 40.—Concluding lesson and examination.

In a subsequent session this class will break up into two sections, one for turners and machinists generally, and the other for fitters and tool-makers. It will then be possible to deal with each part much more thoroughly and satisfactorily. The use of experimental demonstrations in connection with press tool and die-making will be extended, and where such demonstrations cannot conveniently be carried out in the schoolroom, special provision will be made in the shop.

Previous lessons to this class have included in addition matter descriptive of machine tools of various kinds, hand tools, gauges, together with methods of using them properly; the principles of mechanical fitting; feeds and speeds; methods of setting up and clamping work in the lathe, planer, boring mill, and milling machine, etc.

Trade Class for Armature Winders.

Lessons 1-3, 28.—Insulating materials.
„ 4.—Mica products.
„ 5.—Commutators.
„ 6.—Brush gear.
„ 7.—Winder's materials and tools.
„ 8.—Points requiring especial care in winding small direct current machines.
„ 9.—Moulds and formers for armature winding.
„ 10.—Points requiring especial care in winding large direct current machines.
„ 11, 34.—Winding a direct current turbo-generator.
„ 12.—Copper. Its production and use. Grades of copper used in the works. Annealing, soldering, etc.
„ 13.—Breakdowns on direct current machines, their causes and prevention.

Lessons 14.—Insulation and assembly of coils.
„ 15.—Motor starting devices and diagrams for direct current machines.
„ 16.—How the cost of a job is made up.
„ 17.—Manufacturing in bulk. Importance of economy in material. Utilization of scrap.
„ 18-19.—Use of iron and steel in the manufacture of electrical machines.
„ 20-21-30.—Examination and answers.
„ 22.—Standard types of Westinghouse machines.
„ 23-25.—Practical demonstration of the winding and connecting of A.C. mush-wound stators and rotors.
„ 24-26.—Practical demonstration of the winding of A.C. turbo rotors and stators.
„ 27.—How to repair a commutator.
„ 29.—Testing of A.C. stators and rotors. Practical demonstration.
„ 31.—Breakdowns on machines in service.
„ 32.—Practical demonstration of winding and testing small D.C. motors.
„ 33.—Practical demonstration of winding of rotary converter fitted with booster.
„ 35.—Practical demonstration on connecting and testing small D.C. motors.
„ 36.—Insulation of electrical machinery.
„ 37-39.—Starting gear for A.C. motors.
„ 38.—Practical demonstration on barrel windings.
„ 40.—Concluding lesson and examination.

Previous work has covered in addition the causes and prevention of breakdowns in armature coils; general consideration of alternating and direct current windings and coils; mica moulding; mica products; use of winding diagrams, etc.

Trade Class for Electrical Fitters.

Lessons 1-3, 35, 36.—The use of drawings and diagrams.
„ 4-5.—Knife switches.
„ 6-7.—Circuit breakers.
„ 8-9 —Switchboards.
„ 10-11, 33.—Rheostats.

Lessons 12-13, 34.—Direct current starters.
,, 14-15.—Alternating current starters.
,, 16 to 19.—Controllers.
,, 20.—Assembling small motors.
,, 21-22.—Motor building.
,, 23-24.—Jointing of electrical conductors. Soldering.
,, 25-26.—Contactor gear.
,, 27-28.—Brush gear for electrical machines.
,, 29-30.—Special types of Westinghouse switchgear.
,, 31-32.—Use of magnets in switchgear work.
,, 37-38.—Troubles experienced in switchgear testing.
,, 39-40.—Concluding lesson and examination.

Previous courses have included in addition the following points; principles and methods of electrical fitting, properties of insulating materials; assembly of brush gear and commutators; soft and hard soldering.

Trade Class for Transformer Erectors.

Lessons 1 to 3.—Reading transformer electrical specifications. Types of transformers.
,, 4-5.—Coil sketches and diagrams of standard connections.
,, 6.—Coil winding.
,, 7.—What a transformer is for. Magnetic effects. Functions of the parts.
,, 8-9.—Building and machining cores.
,, 10-11.—Insulating and assembling small and large shell type and furnace transformers.
,, 12.—Assembling section coils on core type transformers.
,, 13.—Building up the iron on shell type transformers.
,, 14.—Assembling and insulating core type transformers.
,, 15.—Assembling same, including reactive iron and earth shields, etc.
,, 16-17.—Mounting transformers of all types.
,, 18.—Transformer tanks and oils.
,, 19.—Fitting the transformer in the case, fitting earth leads and earthing devices.
,, 20.—Finishing off ready for shipment.

Trade Class for Pattern-makers.

Lesson 1.—Introduction. Structure of timber.
" 2.—Description of various timbers used in pattern-making.
" 3.—Miscellaneous materials. Allowances in pattern-making.
" 4.—Pattern-maker's tools.
" 5.—Joints in the mould and in the pattern. Loose pieces.
" 6.—Cores and drawbacks. Considerations governing the class of pattern adopted.
" 7.—Rectangular patterns made by boxing up.
" 8.—Principles underlying construction of circular patterns.
" 9.—Core boxes. General principles and examples.
" 10.—Large and complicated core boxes. Strickle boards for cores.
" 11.—Small patterns. Complete description of several examples.
" 12-13.—Medium-sized patterns and core boxes. Examples from modern practice.
" 14.—Patterns for water boxes, centrifugal pump casings, and similar castings.
" 15.—Patterns of apparently fragile construction, as rocker rings.
" 16.—Patterns and cores for a steam engine cylinders.
" 17.—Patterns for large pedestal, engine frame, and similar castings.
" 18.—Patterns for bedplates.
" 19.—Large patterns. Complete description of several examples.
" 20.—Moulds made in cores. Pattern-making work for a large flywheel and armature spider.
" 21.—Loam moulding as it affects the pattern shop.
" 22.—Some examples of pattern-making for loam moulding.
" 23.—Moulding generator yokes, and steam engine cylinders. How the pattern work is made.
" 24.—The pattern work for a surface condenser shell.
" 25.—Loam patterns and loam cores.
" 26.—Sweeping up in green sand. How the pattern-making is modified.
" 27.—Patterns mounted on plates. Some methods, and the precautions necessary.
" 28.—Plate mounted patterns for electrical engineering details.

Lesson 29.—Plaster and metal pattern plates.
,, 30.—Making tackle for moulding, and core making machines.
,, 31.—Moulding pulleys. What the pattern-maker makes.
,, 32.—Gearing patterns. Wheel moulding machines.
,, 33.—Worm gearing. Patterns for screws.
,, 34.—Making cast iron pipes. Standard work, and jobbing work.
,, 35.—Patterns for jobbing work. Makeshifts.
,, 36.—Pattern shop machinery, and its maintenance.
,, 37.—Metal patterns, and the methods by which they are produced.
,, 38.—Pattern shop management. Production and storage.
,, 39-40.—Revision and examination.

In previous sessions the work has included, in addition, methods of economizing in the pattern shop; factors influencing the type of pattern chosen, etc.

TRADE CLASS FOR FOUNDRYMEN.

Lessons 1-2.—General principles of moulding, with simple examples. Plate moulding; loam moulding.
,, 3-4.—Qualities of cast iron in its various grades. The purposes for which each grade is suitable.
,, 5, 33.—Brief description of the cupola and its parts. Various types and latest developments.
,, 6-7.—The cupola charge. What happens to the constituents of it in the cupola.
,, 8.—Cores; uses and manufacture. Core boxes. Core drying.
,, 9, 30.—Moulding a large rope flywheel. Difficulties to contend with. Precautions to adopt to avoid bad castings.
,, 10-11, 25.—Moulding a condenser shell in loam.
,, 12 to 20. Method of moulding other castings in loam and sand, each treated in detail and covering as wide a range as possible.
,, 21.—Moulding a gas engine crank case.
,, 22.—Contraction troubles and some methods of curing them.
,, 23.—Errors in design from the foundryman's standpoint.
,, 24.—Slinging and lifting in the foundry.
,, 26.—Moulding small castings in quantities. Plate moulding.
,, 27-34.—Revision and test.

Lesson 28.—Some ready methods of judging the quality of materials used in moulding.
,, 29.—Use of chills in moulding.
,, 31.—Iron from mine to foundry. Well-known brands of iron, grades of iron.
,, 32.—The chemistry of smelting and purifying iron for foundry use—blast furnaces.
,, 35.—Moulding a turbine cylinder.
,, 36.—Moulding the side frames of a boring mill.
,, 37.—Some notes on reading drawings.
,, 38.—Dry-sand, green-sand, and loam moulding. Typical examples of each class of work.
,, 39.—Special lecture on foundry methods and plant.
,, 40.—Examination.

Matter previously considered includes the use and care of moulders' tools, moulding materials, etc.

CLASS FOR BOOK-KEEPERS AND ACCOUNTANTS. JUNIOR.

Purchases and Sales Books.
Cash Book (1 and 3 columns).
Impersonal Accounts.
Consignment Accounts.
Double Entry Book-keeping.
Journal.
Tabular Day Books.
Departmental Accounts.
Trial Balance.
Trading Accounts.
Bills of Exchange.
Profit and Loss Account.
Balance Sheets.

CLASS FOR BOOK-KEEPERS AND ACCOUNTANTS. SENIOR.

Explanation of the system in vogue in the Westinghouse Accounting Department.
Comparison with the usual English systems.
Reconciliation of the principles in both systems.

Explanation of the following records :—
Voucher Record.
Cash Disbursements Book.
Sales Distribution Book.
Cash Receipts Book.
General Ledger.
Subsidiary Books.

Class for Electrical Testers.

General.

Function of testing department ; personal safety ; general description of parts of direct current machines ; brush bedding ; kinds of brushes ; brush holders ; connecting-up machines for tests ; use of racks and rheostats ; taking speeds and temperatures ; testing polarity ; use and care of instruments.

Direct Current Work.

Technical.

Magnetic circuit in two-pole dynamo. Gramme ring winding. Generation of E.M.F. Drum winding. Methods of excitation. Characteristics of each when running as motor and generator. Effect of brush position on regulation. Multipolar machines. Equalizing rings. Losses in machines. Calculation of efficiency from test results. Heating of machines. Commutation. Commutating poles.

Practical.

Resistance measurements. Saturation curve. Iron loss and mechanical losses. Full load, open circuit and short circuit runs. Regulation. Common causes of sparking and remedies. Insulation test.

Alternating Current Work.

Technical.

Elementary theory of alternating currents.

Practical.

Demonstration with experimental apparatus.

Single-Phase Transformers.

Transformers on open circuit and on load. Causes of voltage drop. Regulation. Losses. A.C. measurements and instruments. Methods of cooling transformers. Banking of transformers.

Tests on single-phase transformers.

Ratio; polarity; resistances. Iron loss and impedance volts. Temperature runs. (1) Dead load. (2) Back to back. Short-circuit runs. Calculation of regulation. Insulation tests.

Special types of transformers.

Shunt, series, and autotransformers. House transformers. Auto starters.

Alternators.

Generation of E.M.F. in single and polyphase alternators. Polyphase circuits. Alternator on load. Losses. Causes of voltage drop. Regulation diagram. Synchronizing and parallel running. Synchronous machine as motor.

Tests on Alternators.

Resistances. Iron loss and open saturation curve. Short-circuit curve and copper loss. Temperature runs. (1) Full load. (2) Open and short circuit runs. Insulation test.

Three-Phase Transformers.

Measurement of power in three-phase circuits. Phase transformation.

Tests on three-phase transformers.

Ratio; polarity; resistances. Iron loss magnetizing current. Copper loss and impedance volts. Temperature runs. (1) Back to back. (2) Delta to Delta. Insulation test.

Induction Motors.

Production of rotating field. Production of torque. Machine on load. Slip. Starting conditions. Pull-out torque. Speed-torque curves.

Tests on induction motors.

Types of motors. Mechanical features. Shop tests. Resistances. Running saturation curve and iron loss. Impedance volts and copper loss. Ratio of transformation. Full load runs. Measurement of slip. Insulation test.

Rotary Converters.

General description of machine. Mechanical features. Ratio of D.C. to A.C. voltages. Balance of A.C. and D.C. Effect on copper loss. Effect of power factor on copper loss and heating. Efficiency. Methods of voltage regulation. (1) Tappings on transformer. (2) Reactance method. (3) Synchronous booster. Conditions affecting commutation. Hunting. Dampers. Inverted rotaries. Three-wire operation.

Tests on rotary converters.

Resistances. Saturation curve and iron loss. Methods of starting. (1) From D.C. end. (2) Self-starting from A.C. end. (3) Starting motor and hand synchronizing. (4) Self-synchronizing with starting motor. Insulation test.

Class for Draughtsmen.

Use and care of instruments.

Printing. Dimensions.

Geometrical problems.

Labour-saving methods.

Forms and proportions of bolts ; screws and nuts ; keys ; riveted joints ; friction and toothed gearing ; pipe joints, etc.

Making freehand sketches of machine parts from actual articles.

Method of measuring same up, and drawing to scale.

The Westinghouse method of machine drawing.

How and where it differs from others.

General arrangement of drawings. Detail drawings.

Working drawings and tracings ; blue prints.

Construction of drawings such as are required for shop use.

APPENDIX II.

SIEMENS & HALSKE'S TRADE SCHOOL.

In summer, school hours are from 7.30 to 8.30 a.m. and 3.30 to 6.30 p.m. In winter, the first afternoon hour is taken from 8.30 to 9.30. The distribution of subjects is as follows :—

Subject.	Class 1.	Class 2.	Class 3.	Class 4.
German . . .	2	1	—	—
Mathematics . .	2	2	2	—
Law . . .	—	1	1	—
Book-keeping .	—	—	1	—
Drawing . .	2	2	2	2
Science . .	—	—	1	—
Technology . .	—	1	1	2
Electrotechnics .	—	—	—	2

German.—Entry to apprenticeship—correspondence with the newspaper—inserting and answering advertisements—composition of letters relating to shop activities—bills and receipts—instructions relating to hygiene, with particular reference to the conditions of the trade—reading of selected passages—recitation—getting out tools and material in the shops—methods of communication, especially by post and railways—applications for insurance—communications with the local authorities and the government about taxes, military service, etc.

Mathematics.—Revision of the four elementary operations and applications to the requirements of the apprentice—problems on money, weights, and measures—tariffs for postal delivery of all kinds—calculations on passenger and goods traffic—commercial and workshop calculations—stocking—works costing. Practical mensuration—wage calculations—insurance problems —household book-keeping—tariffs—taxes—money exchange—elementary algebra and geometry.

Law.—Legal regulations governing apprenticeship—legal position of the workman — overtime regulations — insurance acts—Board of Trade law court—the family and its importance in human society—the municipality, its administration—the German Empire and its constitution—rights and duties of the citizen—compulsory military service and the importance of the army and navy.

Law courts—criminal, commercial, and civil law—importance of colonies—commercial societies—trusts—wholesale manufacture—the small trader—trade and patent law—civil law suits—payment of debts through the courts—bankruptcy—money and credit business—banking—stock exchange.

Book-keeping.—Book-keeping in factories—law relating to bills of exchange.

Technology.—Simple tools for metal and wood work—tools for turning and tapping—tool steels—planing and milling—riveting—welding—soldering—treating metallic surfaces for durability and appearance—qualities of material—iron and steel tempering metals and alloys—wood—insulating materials—pattern-making—moulding—measuring instruments—use of gauges—special tools—wholesale manufacture.

Science.—Elementary mechanics—the phenomena of heat, light, and sound—their bearing on practical questions.

Electrotechnics.—Laws and units of magnetism and electricity—the more important apparatus in telegraphy and telephony—leads and cables for light and heavy currents—electrical measuring instruments—lighting—power transmission.

Drawing.—Use of rule and compasses—elevations—sections—penetration—sketching and dimensioning simple models and preparation of scale drawings—preparation of regular shop drawings—designing special tools and gauges for manufacturing practice.

APPENDIX III.

BIBLIOGRAPHY.

The following list of books, which does not aim at completeness, may be consulted with advantage by those interested in apprentice training.

Primary Education.

Primary Artisan Education. Welpton. (Longmans.)
Educational Process. Bagley. (Macmillan.)
The School. Findlay. (Williams & Norgate.)
School and the Child. Dewey. (Blackie.)
Educational Essays. Dewey. (Blackie.)
Schools of To-morrow. J. and E. Dewey. (Dent.)

Continuation Education.

Continuation Schools in England and Elsewhere. Sadler (Manchester Univ. Press.)
The Problem of the Continuation School. Best and Ogden (King.)

Vocational Selection.

Psychology and Industrial Efficiency. Munsterburg. (Constable.)
The Job, the Man, the Boss. Blackford and Newcomb. (Doubleday, Page & Co., New York.)

Industrial Training.

Industrial Training. N. B. Dearle. (King.)
Idea of the Industrial School. Kerschensteiner—translated by Pintner. (Macmillan.)
Education for Citizenship. Kerschensteiner—translated by Pressland. (Harrap.)
Handbook of Vocational Education. Taylor. (Macmillan.)
Industrial Training of the Boy. McKeever. (Macmillan.)

Industrial Efficiency.

Industrial Efficiency. Shadwell. (Longmans.)
Fatigue and Efficiency. Goldmark. (Russell Sage Foundation, N.Y.)

Bulletins of the United States Bureau of Education.

Vocational Guidance. (No. 14, 1914.)

Education for Efficiency in the Railroad Service. Eaton. (No. 10, 1909.)

Some Trade Schools in Europe. Glynn. (No. 23, 1914.)

The Apprenticeship System in its Relation to Industrial Education. Wright. (No. 6, 1908.)

German Industrial Education. Beckwith. (No. 19, 1913.)

The Public School System of Gary, Ind. Burris. (No. 18, 1914.)

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